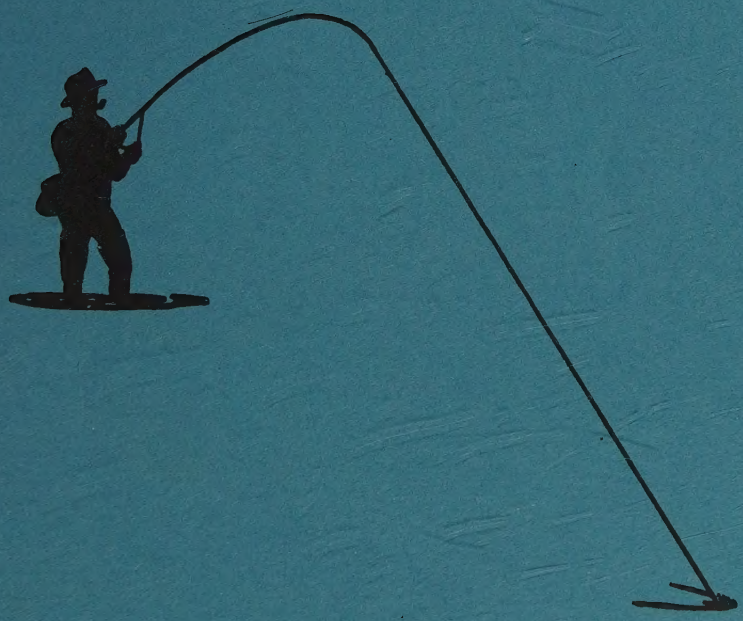
F.W.S.
(1)

9(1)

LIBRARY
JUL 6 1964
FISH & WILDLIFE SERVICE

Sport Fishery Abstracts



Vol. 9 No. 1
Abstracts 6234 - 6440
January 1964

DEPARTMENT OF THE INTERIOR

Stewart L. Udall, Secretary

U. S. FISH AND WILDLIFE SERVICE

Clarence F. Pautzke, Commissioner

BUREAU OF SPORT FISHERIES AND WILDLIFE

Daniel H. Janzen, Director

The printing of this publication
was approved by the Director
of the Bureau of the Budget
January 4, 1961

Washington 25, D. C.

Sport Fishery Abstracts

An abstracting service for fishery research and management

Vol. 9, No. 1 Abstracts 6234 - 6440 January 1964

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes. The last number of each volume contains a list of publications screened for appropriate material.

Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

The Bureau of Sport Fisheries and Wildlife of the U. S. Fish and Wildlife Service assumes no responsibility for the accuracy of material from outside sources, and can only supply copies of articles written and published by the U. S. Fish and Wildlife Service. Requests for other articles should be sent to the author or publisher.

Prepared in the Division of Federal Aid
M. A. Marston, Chief
Paul S. Handwerk, Editor
Angela S. Sutt, Asst. Editor

6234. Underhill, James C. (Zool. Dept., Univ. of Minnesota, St. Paul). 1963. DISTRIBUTION IN MINNESOTA OF THE SUBSPECIES OF THE PERCID FISH ETHEOSTOMA NIGRUM, AND OF THEIR INTERGRADES. The American Midland Naturalist, Vol. 70, No. 2, pp. 470-478.

The squamational patterns of the nape, breast and cheek of the Central Johnny darter, Etheostoma n. nigrum, and the scaly Johnny darter, E. n. eulepis, appear to be determined by incompletely dominate genes at one or a few loci. The distribution of two subspecies and their intergrades in Minnesota is complex. Intergrades, E. n. nigrum, and E. n. eulepis occur in samples from the Red, upper Mississippi, Minnesota and St. Croix drainages. There is little question about the polymorphic nature of the Johnny darters of the Great Lakes region, but several lines of evidence, morphological, ecological and distributional, make it appear undesirable to recognize the scaly Johnny darter, E. n. eulepis, as a subspecies. (Auth.)

6235. Allison, Don (Fish-Pesticide Research Lab., U. S. Bur. Sport Fish. & Wildl., Jackson, Wyoming), Burton J. Kallman, and Oliver B. Cope. 1963. INSECTICIDES: EFFECTS ON CUTTHROAT TROUT OF REPEATED EXPOSURE TO DDT. Science, Vol. 142, No. 3594, pp. 958-961.

Cutthroat trout were periodically exposed to p, p'-DDT, in acetone solution or in the food. Excessive mortality occurred only in lots treated with high concentrations of DDT, probably as a result of decreased resistance to nonspecific stressors. Surviving fish in these lots were significantly larger than those in the control lot, or in the lots treated with low concentrations of DDT. The number and volume of eggs produced was not reduced by DDT, but mortality among sac fry appeared to be highest in the lots treated with high concentrations. The data suggest that the sublethal concentrations of DDT ordinarily encountered in the environment are unlikely to damage a fishery. (Authors)

6236. Hamlin, William H., and Allan W. B. Bé (Lamont Geological Observatory, Columbia Univ., New York). 1963. A PLANKTON PICKER. Deep-Sea Research, Vol. 10, No. 4, pp. 459-461.

An instrument to facilitate rapid and continuous removal of microplankters from liquid samples is described. (Authors)

6237. Derse, Philip H. (Wisconsin Alumni Research Foundation Lab., Univ. of Wisconsin, Madison), and F. M. Strong. 1963. TOXICITY OF ANTIMYCIN TO FISH. Nature, Vol. 200, No. 4906, pp. 600-601.

The test demonstrated that antimycin is an extremely powerful fish toxicant, being 100 percent lethal to goldfish (a resistant species) at a dilution of 1 : 1, 000, 000, 000. Furthermore, it is apparent that, under the test conditions used, antimycin is rapidly degraded since the toxicity of the 1 p. p. b. concentration was eliminated after 1 day and of the 100 p. p. b. concentration after 7 days. (Authors)

6238. Huchson, D. R., and J. M. Sheppard (Sudbury Forest District, Dept. of Lands and Forests, Toronto, Ontario, Canada). 1963. SOME SCUBA OBSERVATIONS FOR THE FRESH-WATER ANGLER. Ontario Fish and Wildlife Review, Vol. 2, No. 2, pp. 15-19.

The use of SCUBA diving techniques has been incorporated into the lake survey program of the Sudbury Forest District. Walleye showed little fear of the observers and could be approached to a distance of from four to six feet before they darted off. Particular attention was given to a school of walleye, 45 fish, located in late June and kept under intermittent observation for 65 days. At no time during 15 observations were these fish found to be more than 150 feet from the original location. Although anglers were informed of this school of fish only one fish was caught. Northern pike were usually found singly and never more than two in a group in larger bodies of water. Pike showed a far larger range of flight; however, a marked tendency to return to the original location after flight was observed. Lake trout were approached to a distance of eight feet. Observations on common shiners, spottail shiners, lake chub, smallmouth bass, sunfish, rock bass, brook trout and suckers were also noted. It appears that only a small percentage of a lake area is populated with fish at any specific time.

6239. Pfeiffer, Wolfgang (Zoologisch-vergl. anatomisches Institut der Universität Zürich, Zurich, Switzerland). 1963. THE MORPHOLOGY OF THE OLFACTORY ORGAN OF THE PACIFIC SALMON (ONCORHYNCHUS). Canadian Journal of Zoology, Vol. 41, No. 7, pp. 1233-1236.

The surface area of the olfactory epithelium of Pacific salmon (Oncorhynchus spp.) is about 40% of the retinal area in 10- to 60-cm fish. In salmon up to 12 cm, growth of the olfactory epithelium occurs by increase in the size and number of the olfactory lamellae, in larger fish only by increase in the size of the lamellae. In adult salmon these primary lamellae develop secondary lamellae which can be seen in the unfixed tissue. The secondary lamellae, up to 10 in each primary lamella, consist only of a non-sensory mucous epithelium. Similar secondary lamellae were found in large rainbow trout (Salmo gairdneri) and seem to be characteristic of salmonids.

6240. Iyengar, V. K. S., D. M. Davies, and H. Kleerekoper (McMaster Univ., Hamilton, Ontario, Canada). 1963. SOME RELATIONSHIPS BETWEEN CHIRONOMIDAE AND THEIR SUBSTRATE IN NINE FRESH-WATER LAKES OF SOUTHERN ONTARIO, CANADA. Archiv für Hydrobiologie, Band 59, Heft 3, pp. 289-310.

The increase in absolute larval weight, in relation to head length, is more rapid in some lakes than others. This is reflected in differences in the

head-length/weight ratio, which is interpreted as indicating "condition" of the larvae at different collection sites.

Sediments with high larval abundance supported larvae of low individual weight.

The chemical composition, growth, and multiplication of the larvae are affected mostly by the total carbon content of the bottom sediment, and to a lesser extent by its total nitrogen and total hydrogen content.

The above elements also influence the carbon/nitrogen ratio and the organic matter content of the larval mass.

Total phosphorus, alone of all the elemental components in the sediment, failed to show any significant influence on any of the elemental components of the larval mass.

Sediments rich in total carbon and total nitrogen support larvae with a relatively low head-length/weight ratio (or of a relatively high weight).

Increase in the total organic matter/absolute weight ratio of the larvae is not accompanied by a proportional increase in the total nitrogen content of the larvae.

Only total phosphorus of the larvae is not influenced by the elemental composition of the sediment.

The larval head-length/weight ratio is inversely related to total phosphorus content of the larvae, a phenomenon which, therefore, may be connected with age and/or fattiness.

The rate of accumulation of fat seems to differ for larvae from different collection sites, and to be related to the abundance of elemental components in the bottom sediments.

Sediments richer in elemental components support a larval population lower in both number and mass.

Sediments low in total nitrogen were high in larval abundance and mass. (Authors)

6241. Rodina, A. G. (Zool. Inst. of the Academy of Sci. of the USSR, Leningrad). 1963. MICROBIOLOGY OF DETRITUS OF LAKES. Limnology and Oceanography, Vol. 8, No. 4, pp. 388-393.

Detritus in seven lakes in the vicinity of Lake Ladoga was investigated by microscopic study by both daylight and by ultraviolet light. The total numbers of microbes and the presence of various physiological groups were determined. The significance of detritus as food for Cladocera has been established experimentally.

Luminescent microscopy has shown that detritus of these lakes is heterogenous--composed chiefly of dying plankton. The detritus consists of a great variety of microscopic biotopes for bacteria, which differ from one another in their structure and chemical characteristics. The study has shown the distribution of bacteria on particles, where the formation of colonies is characteristic. Accumulations of bacteria are components of the detritus.

The numbers of microbes in detritus, billions per g, vary widely, depending on the predominance of various components and the stage of their decay.

The processes of decay of protoplasm of animal and vegetable tissues and the processes of oxidation and reduction are caused by different physiological groups of bacteria: putrefactive, fat and carbohydrate decomposers, amylolytic, pectinous, cellulose decomposers, denitrifying, nitrogen fixers, phosphate liberators, sulfur bacteria, and yeasts. (Auth.)

6242. Small, Lawrence F. (Dept. of Oceanography, Oregon State Univ., Corvallis). 1963. EFFECT OF WIND ON THE DISTRIBUTION OF CHLOROPHYLL a IN CLEAR LAKE, IOWA. Limnology and Oceanography, Vol. 8, No. 4, pp. 426-432.

Distribution of surface chlorophyll a in a shallow, eutrophic lake in north-central Iowa was adequately predicted by an effective chlorophyll-displacement index (EDI) and a displacement vector (DV), which were dependent upon velocity, duration, and directional stability of wind prior to chlorophyll collection dates. Four general wind conditions, determined by the magnitudes of EDI and DV, are considered, and four general conditions of chlorophyll movement are postulated as a direct result of the wind conditions. (Auth.)

6243. Dendy, J. S. (Auburn Univ. Agric. Experimental Station, Auburn, Alabama). 1963. OBSERVATIONS ON BRYOZOAN ECOLOGY IN FARM PONDS. Limnology and Oceanography, Vol. 8, No. 4, pp. 478-482.

Bryozoan colonies were common in farm ponds. Plumatella repens Linnaeus and P. casmiana Oka were dominant. Pectinatella magnifica Leidy occasionally became abundant. Plumatella developed branched colonies when protected from fish; unbranched colonies developed where they were exposed to bluegills. Numerous kinds of animals were associated with bryozoan colonies. Chironomid larvae were dominant cohabitants. (Auth.)

6244. Jones, F. R. Harden (Fish. Lab., Lowestoft, England). 1963. THE REACTION OF FISH TO MOVING BACKGROUNDS. The Journal of Experimental Biology, Vol. 40, No. 3, pp. 437-446.

An apparatus is described to study the response of fish to moving backgrounds. Observations were made on pike, threespine sticklebacks, trout (Salmo trutta), perch (Perca fluviatilis), and roach; cod, whiting-pout, smelt, herring, armed bullhead, lesser weaver, plaice, dabs, soles and dogfish. Pike followed a moving background equivalent to a water current of 0.03 cm/sec. Pike were the best and most consistent performers among the fresh-water species, followed by the threespine stickleback, trout, roach and perch. Marine species fell into two groups. The cod, whiting, whiting-pout, smelt and herring responded to background movements equivalent to water currents of 1-2 cm/sec. The other fish failed to respond to movements equivalent to currents up to 24 cm/sec and it is thought that this may have been due to contact with the bottom. The fish that oriented to

a moving background also responded kinetically. Cod, whiting and whiting-pout gained on the background (swam upstream) at rotational speeds equivalent to water currents less than 1 fish length/sec., but started to lag behind at speeds equivalent to currents faster than 1-2 L/sec., although the fish were shown to be capable of swimming fast enough to keep pace with the background. Herring gained on the background up to rotational speeds equivalent to water currents of 3-4 fish length/sec. The results are discussed in relation to the contranatant theory of fish migration. (Auth.)

6245. Krantz, George E., Jack M. Reddecliff, and Carroll E. Heist (Pennsylvania State Univ., University Park). 1964. IMMUNE RESPONSE OF TROUT TO AEROMONAS SALMONICIDA. PART I. DEVELOPMENT OF AGGLUTINATING ANTIBODIES AND PROTECTIVE IMMUNITY. Prog. Fish-Cult. 26(1): 3-10.

The development of agglutinating antibody to Aeromonas salmonicida in brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) was demonstrated by a tube agglutination test and a rapid slide agglutination test applicable to small samples of fish serum. Trout showed a slow antibody response, reaching maximum titers about 3 months after injection, whereas rabbits given the same treatment showed peak titers within a month. A single injection of formalin-killed bacteria in a mineral oil adjuvant induced high and persistent agglutinin titers in trout. This level of antibody was sufficient to protect trout from experimental challenge. Intraperitoneal injection of the same dose of viable A. salmonicida induced 19% to 100% mortality in untreated controls and trout previously injected with formalin-killed cells without adjuvant. Serological tests and the conditions used for experimental infection gave consistent results without complications frequently reported in experimentation with fish. (Authors)

6246. Larsen, Howard N. (U. S. Bur. Sport Fish. & Wildl., La Crosse, Wisconsin). 1964. COMPARISON OF VARIOUS METHODS OF HEMOGLOBIN DETERMINATION ON CATFISH BLOOD. Prog. Fish-Cult. 26(1): 11-15.

The acid hematin, cyanmethemoglobin, and oxyhemoglobin methods of hemoglobin determination are compared for use on catfish blood. All 3 methods are valid when correction factors are used. The cyanmethemoglobin method is the method of choice, since regression analysis shows the correction factor or standard estimating equation is very similar to that of trout blood. (Auth.)

6247. Moss, D. D., and D. C. Scott (Univ. of Georgia, Athens). 1964. RESPIRATORY METABOLISM OF FAT AND LEAN CHANNEL CATFISH. Prog. Fish-Cult. 26(1): 16-20.

Rates of oxygen consumption were determined for 4 pairs of overfed ("fat") and normally fed ("lean") channel catfish, Ictalurus punctatus, of comparable weights and ages. Fat catfish at 25° C, with one exception, used dissolved oxygen at rates appreciably higher than those of their lean partners. This trend, however, disappeared after the water temperature was raised suddenly to 30° C during the sixth day of the experiment. Metabolic activity for all individuals was increased substantially for a brief period as a result of increase in temperature, after which the fish showed a gradual and progressive decrease in rates of oxygen consumption with time. Oxygen consumption rates at 30° C were only slightly higher than those encountered at 25° C on the fourteenth day, when the experiment was terminated. (Authors)

6248. Phillips, Arthur M., Jr., Glen L. Hammer, and Earl A. Pyle (U. S. Bur. Sport Fish. & Wildl., Cortland, New York). 1964. DRY CONCENTRATES AS COMPLETE TROUT FOODS. Prog. Fish-Cult. 26(1): 21-24.

Three pelleted dry foods, fed as complete diets, have maintained brown trout (Salmo trutta) over an 18-month period. Evidence of nutritional disorders, however, precludes the acceptance of these pelleted foods as complete trout diets under production conditions. (Authors)

6249. Bullock, G. L. (U. S. Bur. Sport Fish. & Wildl., Kearneysville, West Virginia), and A. J. Ross. 1964. CRYSTAL FORMATION IN FURUNCULOSIS AGAR. Prog. Fish-Cult. 26(1): 25-26.

The formation of crystal "colonies" closely resembling bacterial colonies, observed repeatedly in Difco Furunculosis Agar, was studied in uninoculated medium in slants and petri plates held under different storage conditions. An attempt was made to discover the nature of the crystalline material. It was concluded that: (1) though drying of the medium may hasten crystal formation, it does not seem to be the prime factor concerned in the formation of the crystal colonies; (2) there was a difference in the quantity of crystal colonies formed with different lots of medium; (3) a qualitative test indicated that the crystalline material is made up in part or wholly of tyrosine, which is one of the essential components of this medium for pigment production by Aeromonas salmonicida. (Authors)

6250. Lewis, William M., and John Nickum (Southern Illinois Univ., Carbondale). 1964. REARING TROUT IN RACEWAYS SUPPLIED BY WATER FROM THE HYPOLIMNION OF A STRIP MINE POND. Prog. Fish-Cult. 26(1): 27-32.

Under conditions in southern Illinois, some of the ponds formed in the surface mining of coal may have a potential as water supplies for fish hatcheries and rearing units. To investigate this potential, water from a strip mine pond was pumped into raceways and yearling trout were held and fed throughout the summer. This pond and 2 other ponds representing 2 different strip mined areas exhibited marked thermal stratification and thus afforded a supply of cold as well as warm water. They were

characterized by a high sulfate hardness, high manganese, high conductivity, fairly high chlorides, and--in the hypolimnion--some iron. The pH of these waters was in the 6.7 to 7.9 range. Two of the ponds, including the one serving as the water supply to the raceways, had a free carbon dioxide content above 100 ppm in the hypolimnion; in the third pond, however, the free carbon dioxide did not exceed the 10 ppm. During midsummer two of the ponds had very low or no dissolved oxygen in the hypolimnion, but the one with low carbon dioxide had a high dissolved oxygen content in the hypolimnion. To remove the high carbon dioxide and increase the dissolved oxygen, it was necessary to pump the supply for the raceways into an aerating tower prior to use. Trout were satisfactorily held through the summer, showing good survival, growth, and food conversion. (Authors)

6251. Meyer, Fred P. (U. S. Bur. Sport Fish. & Wildl., Stuttgart, Arkansas). 1964. FIELD TREATMENTS OF AEROMONAS LIQUEFACIENS INFECTIONS IN GOLDEN SHINERS. Prog. Fish-Cult. 26(1): 33-35.

A mortality of golden shiners (Notemigonus crysoleucas) caused by Aeromonas liquefaciens was successfully controlled in a 40-acre reservoir by using a terramycin-enriched feed. After feeding on a ration containing 83 g terramycin activity per 100 lb. of feed at the rate of 3% of body weight each day for 8 days, the fish ceased to exhibit lesions. The disease was transmitted experimentally, and the virulence of A. liquefaciens was demonstrated in the laboratory. Symptoms of such infections in golden shiners are described. (Auth.)

6252. Cramer, Frederick K. (U. S. Army Corps of Engineers, Walla Walla, Washington), and Ivan J. Donaldson. 1964. EVOLUTION OF RECOVERY NETS USED IN TESTS ON FISH PASSAGE THROUGH HYDRAULIC TURBINES. Prog. Fish-Cult. 26(1): 36-41.

This paper traces the evolution of the large recovery nets used in recent tests on fish passage through hydraulic turbines and gives examples of efficiency in recapture of fish by this relatively new type of gear. A detailed description is given for the Shasta recovery nets, considered the highest development of this kind of research tool. (Authors)

6253. Meehan, William R. (Alaska Dept. of Fish and Game, Juneau). 1964. A MODIFIED SCOOP TRAP FOR SAMPLING DOWNSTREAM-MIGRANT SALMON IN TURBID GLACIAL RIVERS. Prog. Fish-Cult. 26(1): 42-46.

A scoop trap using the inclined plane principle was constructed and used on the Taku River, Alaska, to sample downstream-migrant juveniles of several species of salmon. After a full season of experimental testing, a standard procedure which would yield a quantitative sample of the seaward migrants was determined. During the spring of 1961, this procedure was followed. The depth of the screen entrance, length of each fishing period, and location of the trap were uniform throughout the study. The trap appears to be a useful tool for sampling downstream-migrant salmon in turbid rivers, and it is possible that any selectivity which may be evidenced is due to the physical characteristics of the trap and/or environmental factors, rather than to avoidance behavior by the fish. (Auth.)

6254. Schoumacher, Roger (Iowa State Cons. Comm., Independence). 1964. A PROJECTION MACHINE FOR EXAMINING FISH SCALES. Prog. Fish-Cult. 26(1): 47.

A scale machine was constructed using the Model No. 60 Bioscope for the optical system. The machine can be built in about two days for less than $35, not including the initial cost of the Bioscope. (Auth.)

6255. Gaver, Frank E. (Idaho Fish and Game Dept., Boise). 1964. A WATER-POWERED AUTOMATIC FRY FEEDER. Prog. Fish-Cult. 26(1): 48.

A water-powered wheel made of marine plywood turns a perforated aluminum pipe that releases fry as it rotates. (Auth.)

6256. Heubach, William, Robert J. Toth, and Alan M. McCready (California Dept. of Fish and Game, Sacramento). 1963. FOOD OF YOUNG-OF-THE-YEAR STRIPED BASS (ROCCUS SAXATILIS) IN THE SACRAMENTO-SAN JOAQUIN RIVER SYSTEM. Calif. Fish and Game 49(4): 224-239.

Approximately 2,500 young-of-the-year striped bass were collected and their stomachs examined for food. By frequency of occurrence, in the summer, bass fed primarily on Neomysis, copepods, cladocerans, and Corophium. Neomysis and Corophium were more important to bass over one inch long than to those under one inch, while copepods were less important to the larger fish. In the fall, the greatest changes were a marked increase in consumption of copepods and a decline in consumption of Neomysis in the San Joaquin River. The bass also fed more on Corophium in the sloughs adjacent to the San Joaquin and Sacramento Rivers. Tendipedid larvae and pupae were the principal food of bass in the fresh-water above the Delta. The occurrence of organisms in the stomachs generally agreed with the distribution of plankton organisms in the environment. (Authors)

6257. Reish, Donald J. (Long Beach State Coll., California). 1963. MASS MORTALITY OF MARINE ORGANISMS ATTRIBUTED TO THE "RED TIDE" IN SOUTHERN CALIFORNIA. Calif. Fish and Game 49(4): 265-270.

Populations of marine fouling and benthic organisms were compared before and after a bloom of Gonyaulax polyedra in the fall, 1962, in Alamitos Bay, California. Population changes were tabulated according to elimination, new appearance, decrease, or increase in numbers. Mortality of invertebrates was probably due to a decrease in dissolved oxygen

brought about by decomposition of dead G. polyedra. (Auth.)

6258. Hayden, Robert P. (California Dept. of Fish and Game, Fresno), and Robert D. Ringo. 1963. INTRODUCTION OF PALAEMONETES PALUDOSUS, A FRESH-WATER SHRIMP, INTO THE LOWER COLORADO RIVER. Calif. Fish and Game 49(4): 304-306.

This shrimp was imported from Florida in 1958. The objective was to improve the food chain in the lower Colorado River. It entered the river from one of the four ponds it was experimentally introduced into and has established itself in a short section above Imperial Dam. Utilization of shrimp by fish in the river was observed in 1962. In 1963 shrimp were planted in seven locations upriver from Imperial Dam. (Authors)

6259. Bell, Robert R. (California Dept. of Fish and Game, Terminal Island). 1963. PRELIMINARY AGE DETERMINATION OF BLUEFIN TUNA, THUNNUS THYNNUS. Calif. Fish and Game 49(4): 307.

Bluefin tuna from the 1961 and 1962 California commercial catch were aged by means of scales. Six age groups, 0 through V, were distinguished with mean lengths of 57.10, 72.08, 90.65, 106.95, 128.50, and 142.00 cm. Scales from 247 fish ranging from 51 to 142 cm fork length were studied. (Auth.)

6260. Orange, Craig J., and Bernard D. Fink (Inter-American Tropical Tuna Comm., La Jolla, California). 1963. MIGRATION OF A TAGGED BLUEFIN TUNA ACROSS THE PACIFIC OCEAN. Calif. Fish and Game 49(4): 307-309.

A bluefin tuna, Thunnus thynnus orientalis, which was tagged at Guadalupe Island, Mexico, during February 1958, was recovered April 1963 at lat. 29° 03' N, long. 139° 42' E, about 300 miles south of Tokyo, Japan. This is the first report of a transpacific migration by bluefin tuna. The fish increased from about 35 to 267 pounds during the 62 months at liberty. (Authors)

6261. Welker, Bill Dean (Iowa Agric. and Home Economics Experiment Station, Ames). 1963. SUMMER FOOD HABITS OF YELLOW BASS AND BLACK BULLHEADS IN CLEAR LAKE. Proceedings of Iowa Academy of Science, Vol. 69, pp. 286-295.

Young yellow bass Roccus mississippiensis ate primarily entomostracans but started taking significant numbers of immature insects when the bass reached 50 mm, total length. Adult yellow bass showed little change in food habits with increase in size from 5 to 7.9 inches with immature insects and crustacea in 60 and 81 percent of the stomachs, respectively. Forage fish were found in only 2 percent of the yellow bass in 1960 compared with 24 percent in1952 and 86 percent in 1943 when the yellow bass were larger. Cladocera decreased in frequency in yellow bass stomachs from June to August 1960. The highest frequencies of copepods, Hyalella, and immature insects occurred in July. The daily period of maximum feeding appeared to be 4 to 8 p.m. with maximum activity, as measured by gill net catches from 6 p.m. to 2 a.m. Black bullheads, Ictalurus melas, ate similar foods to the yellow bass except for a greater utilization of forage fish. (Auth.)

6262. Dinsmore, James J. (Dept. of Zool. and Ent., Iowa State Univ., Ames). 1962. LIFE HISTORY OF THE CREEK CHUB, WITH EMPHASIS ON GROWTH. Proceedings of Iowa Academy of Science, Vol. 69, pp. 296-301.

Age and growth of 151 creek chubs, Semotilus atromaculatus, from the Des Moines River in 1961 were determined by scale and length-frequency methods. The body scale relationship had an intercept of 8.3 millimeters in total length. Chubs reached total lengths of 48, 95, and 128 millimeters at the formation of the first, second and third annuli respectively. Annuli form in May. Weight increased approximately as the cube of the length. The most important food items were plant material, aquatic insects, and, in the case of larger chubs, fish. The chubs were found adaptable in their food habits with the changing conditions of the river. (Auth.)

6263. Watson, John E. (U. S. Bur. Comm. Fish. Biol. Lab., Boothbay Harbor, Maine). 1963. A METHOD FOR TAGGING IMMATURE HERRING. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 451, 7 pp.

A technique for tagging juvenile herring is described. The tag is made of polyvinyl chloride tubing sealed by friction with a V-shaped nylon plug. A hypodermic needle is used to insert the tag through the anterior dorsal musculature. During the 1960 Maine fishing season 8,300 tagged herring were released in lots of 100 and 500 and were recovered at a rate of 0 to 5 percent. Greatest known distance traversed before recovery was approximately 50 nautical miles; greatest speed of travel was 10 miles per day and longest time to recovery was 391 days. The average length of time to recovery was 18 days. (Auth.)

6264. Zimmer, Paul D., Roy J. Wahle, and Eugene M. Maltzeff (U. S. Bur. Comm. Fish., Portland, Oregon). 1963. PROGRESS REPORT, SPRING CHINOOK SALMON TRANSPLANTATION STUDY, 1955-61. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 443, 24 pp.

A study to determine feasibility of introducing spring chinook salmon into Wind River, Washington, has been underway since 1955. In the period 1955-61, 3,221 adult spring chinook salmon have been trapped at Bonneville Dam on the Columbia River and transferred to Carson National Fish Hatchery at Wind River, Washington, for subsequent artificial propagation. The total number of fingerlings released in Wind River, resulting from artificial spawning of adults hauled from Bonneville Dam

and from adults returning to the hatchery, has been 5,078,800.

Partial counts in 1956, 1957, and 1958 at Shipperd Falls fishway, located on Wind River near its mouth, indicate that 10, 1, and 26 spring chinook salmon, respectively, passed through the fishway. Counting was not conducted in 1959. Full-time counting was conducted in 1960 and 1961 at Shipperd Falls fishway and totals of 854 and 1,032 spring chinook salmon, respectively, were tabulated.

Spring chinook salmon adults returning to Carson National Fish Hatchery from releases of fingerlings have been as follows: 1959, 107; 1960, 552; 1961, 610. (Authors)

6265. Carufel, Louis H. (North Dakota Game and Fish Dept., Devils Lake). 1963. LIFE HISTORY OF SAUGERS IN GARRISON RESERVOIR. The Journal of Wildlife Management, Vol. 27, No. 3, pp. 450-456.

Data from Garrison Reservoir and the tailrace area in north-central North Dakota revealed that sauger (Stizostedion canadense) growth rates were better than those reported for other waters, with the exception of Fort Randall and Norris Reservoirs. Garrison Reservoir saugers grew at a faster rate than those from the tailrace. Average calculated total lengths for saugers from Garrison Reservoir at annuli 1-6 were 4.9, 8.7, 12.3, 15.4, 18.4, and 23.1 inches, respectively, whereas those from the tailrace at annuli 1-8 were 4.7, 8.5, 11.3, 13.8, 16.2, 18.7, 20.6, and 25.6 inches, respectively. The average number of eggs per pound of fish was 27,498. Females were more abundant than males, particularly in older age groups. Some male and female saugers mature at 3 years of age. Generally, spawning activities in the Garrison Reservoir and the tailrace take place between the first of May and the end of June. (Auth.)

6266. Scott, W. B. (Dept. of Ichthyology and Herpetology, Royal Ontario Museum, Univ. of Toronto, Toronto, Ontario, Canada), and W. J. Christie. 1963. THE INVASION OF THE LOWER GREAT LAKES BY THE WHITE PERCH, ROCCUS AMERICANUS (GMELIN). Journal of the Fisheries Research Board of Canada, Vol. 20, No. 5, pp. 1189-1195.

Roccus americanus (Gmelin) has become part of the Lake Ontario-St. Lawrence River fauna, originating from populations in Upper New York State. The time required for the species to spread through the lower Great Lakes is discussed and summarized. A review of the morphological distinctions of related species is included. (Authors)

6267. Muir, Barry S. (Dept. of Zool., Univ. of Hawaii, Honolulu). 1963. VITAL STATISTICS OF ESOX MASQUINONGY IN NOGIES CREEK, ONTARIO. I. TAG LOSS, MORTALITY DUE TO TAGGING, AND THE ESTIMATE OF EXPLOITATION. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 5, pp. 1213-1230.

A small population of maskinonge was exploited by a 9-year fishery, using fixed nets under control of the investigator. During the period 1952 to 1960, approximately 4000 maskinonge were handled, 2000 of them being tagged and returned to the population.

The rate of loss of the preopercular disc tag increased progressively with time out, so that an estimated 8.5% of the tags had been lost after the end of the first year, 30% after the second and virtually all after the third. The total mortality and tag loss is estimated to range from 25% to 66% during the period from spring to fall for various years. These estimates are used as correcting factors to determine the numbers of tags extant at the start of the fall fishery each year. The rates of recapture of these tags give estimates of exploitation during the fall fisheries, and the average coefficient of catchability, derived from these data, is 0.0026 for fish age IV and older.

A method, using simultaneous tag and recapture data, is developed to estimate the coefficient of catchability for each age-group. The estimated coefficients of catchability increase, almost linearly, from 0.0013 for age-group III to 0.0032 for age-group VI+. The average coefficient estimated by this method, 0.0025 for age-group IV and older, agrees well with that estimated independently by the method above. (Auth.)

6268. Pinhorn, A. T. (Fish. Res. Bd. of Canada, Biol. Sta., St. John's, Newfoundland), and C. W. Andrews. 1963. EFFECT OF PHOTOPERIODS ON THE REACTIONS OF JUVENILE ATLANTIC SALMON (SALMO SALAR L.) TO LIGHT STIMULI. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 5, pp. 1245-1266.

The reactions to light stimuli of juvenile Atlantic salmon exposed to photoperiods (light-exposed fish) and those exposed to control conditions (control fish) were compared. The light-exposed fish showed more activity and reacted more readily to stimuli than the control fish. Both the control and light-exposed fish exhibited a negative phototaxis at all light intensities except the very lowest where a slight positive phototaxis was obvious. The intensity of an intermittent light stimulus had very little effect on the intensity of the reaction in the light-exposed fish, while the control fish showed an increase in the intensity of the reaction with an increase in the intensity of the light stimulus. The control fish showed an increase in the reaction to the intermittent light stimulus the longer the stimulus was applied at the higher levels of stimulation, while the light-exposed fish showed this behavior at the lower levels of stimulation. The reactions to continuous light were similar to the reactions to intermittent light stimuli, but the light-exposed fish reacted more quickly to continuous light than the control fish. These differences in behavior are attributed to the increased activity and sensitivity of the light-exposed fish, resulting from their exposure to photoperiods. (Authors)

6269. Houston, Arthur H. (Fish. Lab., Dept. of Zool., Univ. of Manitoba, Winnipeg, Manitoba, Canada), and Lawrence T. Threadgold. 1963. BODY FLUID REGULATION IN SMOLTING ATLANTIC SALMON. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, pp. 1355-1369.

Parr-smolt metamorphosis in yearling Atlantic salmon was accompanied by variations in plasma and tissue electrolyte levels, and in tissue water distribution. Plasma chloride declined sharply with the onset of smoltification, but recovered to values somewhat higher than those seen in parr with the attainment of the silvery parr stage. Some decrease, with no evidence of a secondary increase, was observed in tissue chloride concentrations. Changes in chloride space values suggested that parr-smolt metamorphosis is also characterized by a shift of tissue fluids from the extracellular to the cellular phase. These variations in water-electrolyte balance are thought to reflect a premigratory activation and secondary suppression of the extrarenal salt excretion systems employed for osmotic and ionic regulation in sea water. Their occurrence in fish estimated upon the basis of morphological characters to be large parr suggests that the metamorphic process may occur earlier in the life cycle of this species than is generally recognized. (Authors)

6270. Parker, Robert R. (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1963. ON THE PROBLEM OF MAXIMUM YIELD FROM NORTH PACIFIC SOCKEYE SALMON STOCKS. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, pp. 1371-1396.

If it is assumed that rates of exploitation, regardless of where fishing takes place, can be adjusted to the needs for reproduction, maximum yield from stocks of North Pacific sockeye salmon (Oncorhynchus nerka) will then be a function of growth and natural mortality rates. Events during the last decade have demonstrated the vulnerability of this species to pelagic fishing during the penultimate and ultimate years of life. The instantaneous growth rate on a per-month basis (g) is estimated from diverse data by back calculation, tag and recapture, and size-at-time methods. A general consistency of results is apparent regardless of the method utilized. For 2-ocean annuli life history types, penultimate $\bar{g}$ = 0.105, ultimate $\bar{g}$ = 0.111. For 3-ocean annuli types, penultimate g = 0.059, ultimate $\bar{g}$ = 0.075. Ocean mortality models and rates derived by several researchers are reviewed and discussed. Using those proposed by the author, it is shown that the stock mass, hence the allowable yield, increases throughout the penultimate and ultimate years in the sea and reaches a maximum when the stocks approach the coast on the spawning migration. A conservative estimate of the potential increment, based on the 1957-1959 pelagic catches, is 14.2%. It is concluded that the yield of these stocks is seriously depressed by pelagic fishing. (Auth.)

6271. Johnson, R. P. (Saskatchewan Fish. Lab., Saskatoon, Saskatchewan, Canada). 1963. STUDIES ON THE LIFE HISTORY AND ECOLOGY OF THE BIGMOUTH BUFFALO, ICTIOBUS CYPRINELLUS (VALENCIENNES). Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, pp. 1397-1429.

The field study of the bigmouth buffalo (Ictiobus cyprinellus (Valenciennes)), conducted mainly in 1955 and 1956, was concentrated on two small eutrophic lakes in the Qu'Appelle River drainage of Saskatchewan. The bigmouth buffalo reaches its northern limit of range in the Qu'Appelle drainage. Migration into Saskatchewan was probably through postglacial connections at the headwaters of the Mississippi and Red River systems. In the lakes studied, the species prefers water shallower than 5 m.

Length-frequency distributions and age determinations from scale reading show that the population studied was largely the very successful 1948 year-class, produced in a year of extensive flooding. Annulus formation occurred during the second or third week in June. Growth of the 1948 year-class in Pasqua Lake was extremely slow, probably influenced by the cool climate and population density here.

Food of young buffaloes was mainly Cladocera and Copepoda. Larger buffaloes ate about 75% Entomostraca and 15% chironomids, the latter more important as the size of fish increased. Analysis of the living habits of the food eaten, and the feeding mechanism of the buffalo, shows that they occupy a food niche overlapping both bottom feeders and limnetic plankton feeders.

Sexual maturation, especially of females, was extremely slow both in age and size as compared with southern populations. Examination of gonads suggests spawning occurs about May 18-25. Egg measurements indicate that females do not all spawn each year. The contention by other investigators that spawning is "triggered" by addition of fresh-water analogous to normal spring floods of the Mississippi River is supported by the present study.

The population in the Qu'Appelle drainage is probably dependent on the very sporadic production of strong year-classes. A more stable population would require association with regular spring floods of a nearby river or marsh. Commercial removal from the viewpoint of greatest productivity is most economical at the smallest marketable size, as yearly weight gains are probably more than offset by natural mortality. (Auth.)

6272. Lawler, G. H., and G. F. M. Smith (Fish. Res. Bd. of Canada, Biol. Sta., London, Ontario, Canada). 1963. USE OF COLORED TAGS IN FISH POPULATION ESTIMATES. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, pp. 1431-1434.

Transparent colorless and opaque yellow tags of several types were applied to small perch, less

than 15 cm in length, and larger suckers, 17 cm and greater, in Heming Lake, Manitoba, Canada. The return of opaque yellow tags was significantly smaller than that of clear transparent tags (less than one-half) for the small fish only. Tag type was relatively unimportant. This is interpreted as a higher predation rate, by pike, on small fish with opaque yellow tags. (Authors)

6273. Sehdev, H. S., J. R. McBride, and U. H. M. Fagerlund (Fish. Res. Bd. of Canada, Tech. Res. Lab., Vancouver, B. C., Canada). 1963. 2-PHENOXYETHANOL AS A GENERAL ANESTHETIC FOR SOCKEYE SALMON. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, pp. 1435-1440.

The dose--response relationship of 2-phenoxyethanol, as a general anesthetic, in adult sockeye salmon (Oncorhynchus nerka) has been investigated. At 11° C the effective dose (ED_{50}) and lethal dose (LD_{50}) were approximately 43 and 130 ml/100 Imperial gal, respectively. The therapeutic ratio $\frac{LD_{50}}{ED_{50}}$ was more than 3, indicating a good margin of safety. At a lowered aquarium temperature of 4° C the anesthetic effects of 2-phenoxyethanol were potentiated. ED_{50} and LD_{50} at this temperature were approximately 25 and 130 ml/100 gal of water, respectively. The therapeutic ratio was more than 5, indicating that the margin of safety was increased by the decrease in temperature. (Authors)

6274. Parker, Robert R. (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1963. EFFECTS OF FORMALIN ON LENGTH AND WEIGHT OF FISHES. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, pp. 1441-1455.

Sockeye smolts, pink and chum fry, and pink and chum fingerlings (Oncorhynchus) were sequentially weighed and measured when alive and after death in water and after killing and storage in formalin up to 225 days. The fish shrank within 12 hours to 97% and by 30-40 days to 96% of live length. Further changes in length were not significant. These same relative changes were observed from fish of different sizes, and the values were not significantly different among groups preserved in formaldehyde solutions of fresh or sea water. In fresh water, fish gained weight while yet alive but under anesthesia. In fresh-water formalin, fish gained weight rapidly for 1 or 2 days, then lost weight at a decelerating rate to the time of last measurement. Fish killed and stored in salt water formalin lost weight for the first few days, then gained weight at a decelerating rate. Relative magnitudes and rates of change were inversely related to size of specimens contained in the sample. These changes had pronounced effects on relative condition factors which varied from 97 to 135% of live values depending upon size of fish, type of formalin and time in preservative. (Auth.)

6275. Fagerlund, U. H. M., J. R. McBride, M. Smith, and N. Tomlinson (Fish. Res. Bd. of Canada, Tech. Res. Lab., Vancouver, B. C., Canada). 1963. OLFACTORY PERCEPTION IN MIGRATING SALMON. III. STIMULANTS FOR ADULT SOCKEYE SALMON (ONCORHYNCHUS NERKA) IN HOME STREAM WATERS. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, pp. 1457-1463.

Adult sockeye salmon (Oncorhynchus nerka) captured during their spawning migration to Great Central Lake, British Columbia, show a consistent response in the laboratory to water taken from the outlet of the lake. The specificity of this response has been confirmed and the responses to water from streams feeding Great Central Lake have been determined. A portion at least of the stimulatory material is volatile and can be retained in a cold trap. Concentration of the active factor has been achieved by a freezing-out technique. (Authors)

6276. Lawler, G. H. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ontario, Canada). 1963. SPRING STAINLESS STEEL ANCHOR TAG. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 6, p. 1553.

A tag consisting of a small stainless steel anchor with the identifying disc attached by either stainless steel, tantalum wire or monofilament nylon is described. In 1961 a total of 2408 of these tags were applied to yellow perch, common suckers, burbot and northern pike. Eighteen percent of these fish were recaptured in 1961 and 1962.

6277. Barry, Edwin M. (Maryland Game and Inland Fish Comm., Annapolis). 1962. INLAND FISH MANAGEMENT. (ANNUAL REPORT OF THE MARYLAND GAME AND INLAND FISH COMMISSION.) Maryland Conservationist 39(6): 16-27; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20182. 1963.

6278. Goryunova, S. V. 1961. LUMINESCENT ANALYSIS METHODS IN STUDIES OF PROBLEMS ON PRIMARY PRODUCTIVITY. (METODY LYUMINESTSENTNOGO ANALIZA PRI IZUCHENII VOPROSOV PERVICHNOI PRODUKTSII.) Minsk. 256-261; Referat. Zhur., Biol., 1962, No. 16Zh496; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20488. 1963.

Methods of luminescent analysis can be used for direct counts of primary productivity, as well as its qualitative evaluation. As an example, the author describes the micromethod of determining chlorophyll in sea water as submitted by Kalle and based on measurements of red fluorescence of chlorophyll extracts. Principles of the method in question are stated to be quite promising. A number of examples are cited for qualitative evaluation of primary productivity with the aid of luminescent microscopy. The article cites in part the basic results of studies on interrelations between the

hydrological features and processes of development and decomposition of phytoplankton in the Norwegian Sea, as well as studies of the processes of decomposition of diatoms in sediments of this and other seas. The use of luminescent microscopy made it possible to obtain interesting data on developmental cycles of a number of phytoplankton forms in the Beloe (Kosino, Moskovskaya oblast').

6279. Hynes, H. B. N. (Dept. Zool., Univ. of Liverpool, Liverpool, England), and F. W. Roberts. 1962. THE BIOLOGICAL EFFECTS OF SYNTHETIC DETERGENTS IN THE RIVER LEE, HERTFORDSHIRE. Ann. Appl. Biol. 50(4): 779-790; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20536. 1963.

The fauna and flora of the River Lee were studied between 1950 and 1961. The River Lee consists primarily of sewage effluent, very well purified, derived from the town of Luton. The detergent content of the purified effluent rose from 1 to 4 ppm between 1950 and 1958 but fell steeply to 2.0 ppm in 1960 following the "Luton Experiment" when soft or biologically degradable detergents were substituted for the normal "hard" or resistant variety in the town. No marked changes in the fauna which could be correlated with the changes in detergent concentration were found but experiment showed that the scarcity of certain plant species in the river could be due to the detergent in the river water. (Authors)

6280. Ivanova, M. B. 1961. USE OF THE CHLOROPHYLL METHOD IN STUDYING THE PRIMARY PRODUCTIVITY OF A DYSTROPHIC LAKE. (PRIMENENIE KHLOROFIL'NOGO METODA PRI IZUCHENII PERVICHNOI PRODUKTIVNOSTI DISTROFNOGO OZERA.) Minsk. 242-248; Referat. Zhur., Biol., 1962, No. 21Zh388; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20537. 1963.

As a basis for determining chlorophyll in plankton from Lake Krasavitsa principles of the Ensch method, used for measurement in a Pulfrich photometer, were established. The standing crop of phytoplankton was determined at the same time. In general variations in the amount of chlorophyll responded to variations in the standing crop of phytoplankton, but its spread was considerably smaller. The assimilation number (1 mg O_2/mg chlorophyll/day) varied greatly. The maximum number (242.4) was observed in August 1959. Because of the amount of chlorophyll in it (0.015-0.0019 mg/l), Lake Krasavitsa is classified as an unproductive body of water. This agrees with data on the standing crop and the photosynthesis of phytoplankton.

6281. Lenhard, G., W. R. Ross, and A. du Plooy (Natl. Inst. Water Res., Pretoria, S. Africa). 1962. A STUDY OF METHODS FOR THE CLASSIFICATION OF BOTTOM DEPOSITS OF NATURAL WATERS. Hydrobiologia 20(3): 223-240; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20543. 1963.

A number of tests used in the study of agricultural soils are applied to the sediments of the River Apies near Pretoria in order to determine the part played by the sediment in the self-purification of the polluted parts of the river. The cation exchange capacity indicates the extent to which ion exchange can remove basic organic substances as well as inorganic salts from the water. The dehydrogenase activity is a measure of the extent of biological breakdown of organic substances. The quantity of water soluble and exchangeable ions shows the amount of mineral salts readily available to microorganisms which may determine the extent of microbiological activity. The degree of humification is a measure of the stabilization of organic substances in the sediment and is inversely related to the degree of pollution. (K. E. M.)

6282. Matisone, M. 1961. PRIMARY-PRODUCTIVITY OF PLANKTON IN PONDS OF THE LATVIAN SSR. (PERVICHNAYA PRODUKTSIYA PLANKTONA V PRUDAKH LATVIISKOI SSR.) Minsk. 159-164; Referat. Zhur., Biol., 1962, No. 16Zh498; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20547. 1963.

Studies with the aid of a modification of the oxygen flask method have shown that the total primary production of the surface layer (0-0.5 m) in the most productive ponds approached 5-10 mg of O_2 per liter. The production decreased gradually as depth increased. Introduction of fertilizers into the ponds resulted in 2 peaks of photosynthesis, at the beginning of July and the middle of August. The use of one type of mineral fertilizer led to an increase in intensity of photosynthesis, mainly in the surface horizon. Peak effects were noted in applications of mixed organic-mineral fertilizers, in which instances the intensity of photosynthesis occurred in deeper water layers as well. At the same time, the destruction of organic substance intensified also in that instance. Two patterns of relations between photosynthesis and destruction were noted. The two factors were normally found in a direct relation: destruction of organic matter intensified with an increase in photosynthesis. However, in a number of instances where matter of nonplanktonic origin affected the destruction process substantially, the relation between photosynthesis and destruction became inverse. This was also facilitated by the establishment of thermal stratification in the ponds. The ratio of photosynthesis to destruction in ponds on the farm Rita-Ausma fluctuated between 0.30 and 7.71. The magnitude of this relation corresponded to the intensity of phytoplankton development in the ponds. Peak values were obtained in ponds where massive development of blue-green algae occurred, lowest values in ponds with weak phytoplankton development.

6283. Zhadin, V. I., T. V. Zharova, and N. G. Ozeretskovakaya. 1961. ON THE USE OF RADIOACTIVE CARBON AND OXYGEN METHODS IN STUDYING THE PRIMARY PRODUCTION OF LAKE KRASAVITSA. (O PRIMENENII RADIOUGLEROD-

NOGO I KISLORODNOGO METODOV PRI IZUCHENII PERVICHNOI PRODUKTSII OZ. KRASAVITSA.) Minsk. 195-203; Referat. Zhur., Biol., 1962, No. 21Zh389; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20559. 1963.

On the basis of data on the hydrology and chemical composition of water and some information about the phytoplankton, benthos, and ichthyofauna, Lake Krasavitsa is classified in the group of humified lakes having a current, a relatively low degree of oxygenation of the water, and a low biological productivity. Comparison of results obtained by studying the primary production by radioactive carbon and oxygen methods showed that the extent of production obtained by the radioactive carbon method was equal to or slightly lower than the extent of the net production. In this the extent of production which was obtained was closer to the extent of primary production in oligotrophic lakes.

6284. Abakumov, V. A. 1961. METHODS OF STUDYING CHANGES IN INCREMENTS OF WEIGHT AND LENGTH IN FISHES. (METODIKA IZUCHENIYA DINAMIKI VESOVOGO I LINEINOGO PRIROSTA RYB.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 13. 194-201; Referat. Zhur., Biol., 1962, No. 19I30; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20560. 1963.

A critical analysis of existing methods of determining the quantitative regularities in fish growth is presented. It is necessary to calculate specific characteristics of growth for each species, including growth in weight as well as length, (which have different characteristics).

6285. Arve, John. 1962. EXPERIMENTS WITH "CHEMICAL DAMS." Maryland Conservationist 39(5): 13-15; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20566. 1963.

Polyethylene sheeting is used to form a dam, and rotenone is applied behind it to kill the fish stock of a small section of a reservoir for study.

6286. Assman, A. 1961. ACCESSIBILITY OF CHIRONOMID LARVAE TO FISH. (O DOSTUPNOSTI LICHINOK KHIRONOMID DLYA RYB.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 13. 361-363; Referat. Zhur., Biol., 1962, No. 18I42. 1963.

The study concerned accessibility of chironomid larvae to Cyprinus carpio, Abramis brama, Rutilus rutilus caspicus and Carassius auratus. Observations were conducted in nylon cages placed in a body of water. Peak consumption of the chironomid larvae was noted in cages containing Cyprinus carpio, with Abramis brama second. Rutilus caspicus and C. auratus show lower consumption than the carp and bream. Intensity of consumption is also governed by the density of stocking of the fish. The accessibility of chironomid larvae to fish is governed not only by the depth of their penetration into the ground, but also by their population density in the ground. On the other hand, consumption of the chironomid larvae by carp affects their vertical distribution in the bottom.

6287. Baldwin, Norman S., and Robert W. Saalfeld (Nat. Resources Bldg., Univ. of Michigan, Ann Arbor). 1962. COMMERCIAL FISH PRODUCTION IN THE GREAT LAKES 1867-1960. Great Lakes Fish. Comm. Tech. Rept. 3. 1-166; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20568. 1963.

6288. Berezina, N. 1962. CONTROL OF PREDATORY AQUATIC INSECTS. (BOR'BA S KHISHCHNYMI VODNYMI NASEKOMYMI.) Rybovodstvo i Rybolovstvo 5. 25-26; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20571. 1963.

Aquatic beetles and bugs and dragonflies are a serious problem in ponds where there are small fish, because insects eat the fish and compete with them for food. Although pyrethrum and kerosene effectively control insects breathing atmospheric O_2 and are harmless to fish, they have no effect on insects which breathe underwater. The author carried out experiments with 24 watt white and 75 watt blue incandescent lamps in benthonic basins (volume approximately 1 m^3). The lamps were used with traps of various sizes and shapes. Sixteen experiments were performed with insects and 4 with crucian carp (Carassius carassius) and the cyprinid Leucaspius delineatus. Large numbers of the following were caught in the traps: dragonfly nymphs of the family Aeshnidae, damselflies (Zygoptera), caddis larvae, and also adult Notonectidae and bugs of the genus Acilius. After 4 hrs, 50-100% of these insects were trapped. Libellulid dragonfly nymphs did not react very strongly to the light. In all of the experiments white light was more effective than blue for attracting insects. The effect of white and blue light on crucian carp and L. delineatus was identical. After 4 hrs, 45-58% of the fish had gathered at the lights. The lights had the same effect on fish which had been fed and those which were fasting. The author recommends that traps be at least 50 cm long. Otherwise, the lamp is too close to the inlet opening and too much heat is produced. Since light traps attract both fish and insect pests, they should only be used to clean ponds before they have been stocked with fish. Traps with Hg-vapor lamps can be used in ponds with fish since the fish cannot perceive ultraviolet radiation. (M. D.)

6289. Borshosh, A. V., and V. V. Illesh (Sovnarkhoz, Stanislav, USSR). 1962. ELIMINATION OF ICHTHYOPHTHIRIUS FROM FISH PONDS. (OZDOROVLENIE VODOEMOV OT IKHTIOFTIRIOZA RYB.) Veterinariya 11. 50; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20575. 1963.

To eliminate Ichthyophthirius among young rainbow trout at a fish farm, treatment of the fry with NaCl and $KMnO_4$ was tried without success. Addition of biomycin to the food given to the fry proved effective; no cases of Ichthyophthirius occurred among fish which had received biomycin.

6290. Devi, Katragadda Vijaya Lakshmi. 1962. THE EFFECTS OF TURBIDITY AND OF LIGHT ON THE TOXICITY OF TWO ROTENONE FORMULATIONS TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS). Dissert. Absts. 23(3): 1124-1125; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20587. 1963.

6291. Doi, Takayuki (Tokai Reg. Fish. Res. Lab., Tokyo, Japan). 1962. ON THE PREDATORY AND COMPETITIVE RELATIONSHIPS AMONG FISHES CAUGHT IN THE WATERS ADJACENT TO JAPAN. Bull. Tokai Reg. Fish. Res. Lab. 32. 49-121; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20589. 1963.

Predator-prey relationships, in addition to the effects of fishing, must be considered in studying communities. This has been done for various fish in Japanese waters by application of Volterra's equations using data from catches over a period of years. An analog computer was used to solve differential equations which predict population sizes. Problems of mathematical models are considered.

6292. Dryagin, P. A. 1961. BIOLOGICAL BASES OF CONTROLLED FORMATION OF FISH STOCKS IN RESERVOIRS. (BIOLOGICHESKEI OSNOVY NAPRAVLENNOGO FORMIROVANIYA RYBNYKH RESURSOV V VODOKHRANILISHCHAKH.) Akad. Nauk SSSR: Moskva-Leningrad. 18-25; Referat. Zhur., Biol., 1962, No. 15I78; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20591. 1963.

In the creation of reservoirs it is necessary to take into consideration the biological differences between fishes, the dynamics of the numbers of individual local stocks, and the fish productivity of each reservoir. The presence of intra-specific categories in fish (subspecies, geographic races, populations, local schools) has great practical significance. Introduction into a reservoir of biologically heterogeneous local schools of a single species assures the most complete utilization of the food resources of the body of water. The intra-species heterogeneity can be used for the breeding of new stocks and the improvement of the natural quality of fish.

6293. Eremeeva, E. F. 1961. DEVELOPMENT BY STAGE AND THE DYNAMICS OF FISH ABUNDANCE. (ETAPNOST' RAZVITIYA I DINAMIKA CHISLENNOSTI RYB.) Tr. Soveshchanii. Ikhtiol. Komis. Akad. Nauk. USSR 13. 180-184; Referat. Zhur., Biol., 1962, No. 21I35; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20592. 1963.

The theory of development by stages considers the organism as a unification of all moments of its development. The theory of ecological groups of fishes concerns itself with the ecological distinctiveness of a species, in toto, providing materials for the understanding of the relationships between different ecological groups in nature. The theory of self-regulation of population size reveals a pattern of population changes, primarily of sexually mature fish. All three theories reflect different aspects of the concept of the unity of organism and its environment, and, thus, should serve as the bases for understanding the dynamics of fish numbers.

6294. Herbert, D. W. M. (Water Pollution Res. Lab., Stevenage, England). 1962. THE TOXICITY TO RAINBOW TROUT (SALMO GAIRDNERI) OF SPENT STILL LIQUORS FROM THE DISTILLATION OF COAL. Ann. Appl. Biol. 50(4): 755-777; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20607. 1963.

The toxicity to rainbow trout of spent still liquors from the manufacture of town gas is shown to be due mainly to the ammonia and the monohydric phenols they contain. The toxicity of the mixtures of monohydric phenols occurring in such liquors is approximately equal to that of pure phenol, and further experiments show that the hardness, pH value, and temperature of the test solutions do not alter the threshold of toxic concentration of the phenolic mixtures, although their toxicity is increased by a reduction in dissolved-oxygen concentration. In a given dilution water, mixtures of ammonia and monohydric phenols are found to be at their threshold concentration when $A_S/A_T + P_S/P_T = 1$, A_S and P_S being the concentrations of ammonia and phenols in solution and A_T and P_T the threshold concentrations for these poisons when tested singly in the same dilution water. Determinations, both in the laboratory and in a polluted river, of the toxicity of spent liquors were compared with the toxicity expected from chemical analysis of the solutions and it is considered that the agreement between prediction and observation is good enough for the predictive method to be used as a basis for deciding what treatment the effluent should receive to make it safe for fish after discharge. (Auth.)

6295. Holbert, Leon R. (Box 37, Wylie, Texas). 1961. TASTE AND ODOR EXPERIENCES USING ROTENONE PRODUCTS (IN LAKES). Proc. Texas Water Sewage Works Assoc. Short Sch. 42: 230-233; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20608. 1963.

Type, intensity and duration of odors produced by treating reservoirs with 0.5, 1 and 1.5 ppm of 5 rotenone preparations are noted. Only 5% powdered rotenone or ChemFish Synergized HFN should be used in municipal water supplies. (G. A. E.)

6296. Hoopes, David Townsend (U. S. Bur. Comm. Fish., Biol. Lab., Auke Bay, Alaska). 1962. ECOLOGICAL DISTRIBUTION OF SPAWNING SOCKEYE SALMON (ONCORHYNCHUS NERKA) IN THREE LATERAL STREAMS, BROOKS LAKE, ALASKA. Dissert. Absts. 23(3): 1125; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20609. 1963.

6297. Ivlev, V. S. 1961. UTILIZATION OF FOOD BY PLANKTOPHAGOUS FISH. (OB UTILIZATSII PISHCHI RYBAMI-PLANKTOFAGAMI.)

Tr. Sevastopol'sk. Biol. Sta. Akad. Nauk SSSR 14. 188-201; Referat. Zhur., Biol., 1962, No. 18I39; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20613. 1963.

The transfer of energy from one level to another (the plankton-fish link) was studied on a homogeneous population of Alburnus fry. Mean daily growth during the period of observation Q' = 5.025 cal, the average concentration of food p = 808 cal/m^3. Individual ration $r = R(1-10^{-\beta p})$, where R is the maximum ration and β is the coefficient of proportionality. Experimentation served to determine R = 15.6 cal. and $\beta = 0.00016$. Total metabolism Q and basal metabolism Q_s were linked by the relationship $Q = Q_s + MV^n$, where V is the velocity of motion (in cm/sec), while m and n are coefficients equal to 0.036 and 1.81 respectively. Hence, Q = 1.81 cal/hour. Daily ration $Q_+ = aR(1-10^{-\beta p})$, where a is the number of hours during which the fish feeds. Correspondingly, daily energy consumption $Q_- = a(Q - Q_s) + 24Q_s$ and:

$$a = \frac{Q' - 24Q_s}{0.8R\,(1-10^{-\beta p})-(Q-Q_s)} = 9.6 \text{ hours.}$$

Another relationship is:

$$a = \frac{R_c\,(1-10^{-\beta_1 p})}{R\,(1-10^{-\beta p})}$$

where R_c is the maximum daily ration and β_1 is the coefficient of proportionality, i.e., the number of hours the fish feeds is equal to the ratio of daily to hourly rations. At a terminally high concentration of food $a_{min} = \frac{R_c}{R}$; at p = O: $a_{max} = \lim_{p \to O} \frac{R_s\,(1-10^{-\beta_1 p})}{R\,(1-10^{-\beta p})}$

By a similar process a = 15 hours was calculated for fry of Clupea sprattus from the Gulf of Finland; i.e., the fry of C. sprattus feeding during all daylight hours at the observed concentration of plankton.

6298. Kipper, Z. M. 1961. USE OF NAVIGATION LOCKS AT HYDROELECTRIC STATIONS FOR THE PASSAGE OF FISH FROM DOWNSTREAM INTO THE RESERVOIR. (OB ISPOL'ZOVANII SUDOKHODNYKH SHLYUZOV GES DLYA PROPUSKA RYBY IZ NIZHNEGO B'EFA V VODOKHRANILISHCHE.) Akad. Nauk SSSR: Moscow-Leningrad 239-243; Referat. Zhur., Biol., 1962, No. 19I105; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20619. 1963.

The possibility of using navigation locks at hydroelectric dams for passing fish upstream was studied on the low-head locks of the Ust'-Manychsh and Aparin developments, and the medium-head locks at the Tsimlyan and Kegum developments. Fish approached the site of maximum water velocity downstream from the dam. Various rates of flow were tested in the navigation approach canal and in the locks themselves. It was found that non-migratory fish, chiefly, were attracted into the approach canal; a large number of the migratory fish went right past it (and on up to the dam). In the Kegum lock the fish passed freely from the lower chamber into the upper with a flow rate of 0.1-0.3 m/second in the course of 10-30 min. Discharge of water at a rate of 0.20-0.4 m/second increased the entrance of fish into the lock. Setting up of guiding nets in the river channels contributed to an increased entry of fish into the approach canal. Experiments with marked Vimba vimba showed that up to 80% of the fish planted in the lower chamber passed to the upper chamber of the lock.

6299. Lebedev, V. D. 1961. EFFECT OF FISHERIES ON THE BIOLOGICAL CHARACTERISTICS OF FISHES (BASED ON ARCHAEOLOGICAL DATA). (VOZDEISTVIE PROMYSLA NA BIOLOGICHESKIE POKAZATELI RYB (PO ARKHEOLOGICHESKIM MATERIALAM).) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 13. 173-179; Referat. Zhur., Biol., 1962, No. 18I38; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20631. 1963.

Analysis of fish fossils from archaeological finds permitted a determination of the character of fish fauna before the effects of intensive commercial activity. Maximum size and age of fish from settlements of the early man was approximately the same as or deviated only insignificantly from comparable values for present day fish. However, the average size of commercial fish (Esox lucius, Blicca bjoerkna, Abramis brama, Perca fluviatilis and Stizostedion sandra) was larger in the early settlements than it is at present. On the other hand, average size of non-commercial species (Tinca tinca) was little different. This is observable also in bodies of water where intensive commercial activity is absent. The rate of growth of commercial fish in bodies of water subject of intensive commercial activity is greater (and the percentage of the older age groups is less) at the present time than in the past. The commercial value of various species has changed as well. Some species have lost all economic importance (Baltic sturgeon), while the ranges of numerous migratory species contracted. The number of carnivorous fish has decreased with fishing, which has led to an increase in fish of little or no commercial value.

6300. Lyubitskaya', A. I. 1961. EFFECT OF VISIBLE LIGHT, ULTRAVIOLET RAYS AND TEMPERATURE ON BODY METAMERISM OF FISH. I. EFFECT OF DIFFERENT PARTS OF THE VISIBLE SPECTRUM, DARKNESS AND TEMPERATURE ON SURVIVAL AND BODY METAMERISM OF FISH. (VLIYANIE VIDIMOGO SVETA, UL'TRAFIOLETOVYKH LUCHEI I TEMPERATURY NA METAMERIYU TELA RYB. I. VLIYANIE RAZLICHNYKH CHASTEI VIDIMOGO SPEKTRA, TEMNOTY I TEMPERATURY NA VYZHIVANIE I METAMERIYU TELA RYB.) Zool. Zhur. 40(3): 397-407; Referat. Zhur., Biol., 1962, No. 19I12; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20635. 1963.

The growth of embryos of smelt, pike, ruff (Acerina) and perch were studied during their incubation under conditions of varying temperature and light regimes. Visible light, no less than temperature, had an effect on the rate of growth in the fish and on the process of tissue differentiation. The absence of all visible and thermal parts

of the spectrum caused an increase or decrease in the number of metameres or the formation of deformities. In experiments on pike, it was shown that darkness suppressed the activity of the hatching gland.

6301. Prieditis, A. 1962. ARTIFICIAL FOOD FOR TROUT WITH SUPPLEMENTS OF TRACE SUBSTANCES. (ISKUSSTVENNYE KORMA S MIKRODOBAVKAMI DLYA FORELI.) Rybovodstvo i Rybolovstvo 3. 15-16; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20660. 1963.

Rainbow trout (Salmo irideus) were raised from eggs. For about the first 28 days the young fed on zooplankton and smelts (spleen). Then they were placed in an Atkins apparatus for 86 days and fed a basic diet consisting of fish paste (40%), beef spleen (20%), beef blood (25%), and rye meal (15%). Riboflavin and lecithin were added in the form of peas and horse beans (Vicia faba var. equina). Food was heated in a 2-stage vacuum apparatus at 40-55° C. In addition to the basic ration, fish in experimental groups were fed supplements of trace substances. At the end of the experiment trout receiving antibiotics (procain, penicillin and biomycin, 25 mg/kg food), trace minerals ($CoCO_3$, $ZnCO_3$, $CuCO_3$, and $MnCO_3$ 10 mg/kg each), and horse beans (15% of the total weight) had the highest average weight (3.5 g, 170% of the average control weight). Only 10% of these fish died, while 20% of those in the control group did. Trout receiving $MnCO_3$ weighed 2.9 g (133.2% of the average control weight); those receiving $ZnCO_3$, 2.4 g (109%); those receiving $CoCO_3$, (119%); antibiotics, 2.7 and 2.6 g (123%); horse beans, 2.6 g (120%). The effect of each of these substances on the physiological functions of the fish is discussed. (M. D.)

6302. Swift, D. R. (Freshwater Biol. Assoc., Ambleside, Westmorland, England). 1962. ACTIVITY CYCLES IN THE BROWN TROUT (SALMO TRUTTA LIN.). I. FISH FEEDING NATURALLY. Hydrobiologia 29(3): 241-247; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20689. 1963.

The annual and diurnal activity cycle for 4 naturally feeding brown trout separately confined in netting cages on the bed of Windermere is described. All the fish showed a similar annual cycle of maximum activity during May and June, one fish showing a second activity peak during the autumn. The fish also showed similar diurnal activity rhythms of low activity during the night and increased activity during the day, with a pronounced increase at dawn. The possible influence of light and temperature on the fishes activity is briefly discussed. (Auth.)

6303. Vibert, R. 1962. MIGRATIONS OF SALMON AND THEIR RETURN TO THEIR NATIVE RIVER. (VIAJES DE LOS SALMONES Y REGRESO AL RIO NATAL.) Montes 18(107): 385-395; Biological Abstracts, Vol. 42, No. 6, Abst. No. 20697. 1963.

A review of studies on migration of salmon, made in Canada, USA, Norway, England, France, and other countries. Bibliography: 39 references. (W. N. S.)

6304. Opalatenko, L. K. 1961. CONCERNING METHODS OF STUDYING BREATHING IN FISH. (DO METODYKY DOSLIDZHENNYA DYKHANNYA U RYB.) Nauk. Zap. Nauk. Prirodozn. Muz. Akad. Nauk. Ukrain. SSR 9. 76-79; Referat. Zhur., Biol., 1962, No. 22I2; Biological Abstracts, Vol. 42, No. 6, Abst. No. 21487. 1963.

A device for recording pressure changes in gill cavities of fish is described. Pressure changes were observed by means of a manometer containing a dyed water column illuminated by a beam of light. After passing through the slit in the kymograph housing, the light produced an image of a curve at the white-and-dark border of the photopaper. Time was measured with an induction coil, a small shutter arm being attached to the interrupter hammer of the coil.

6305. Shelton, G., and D. J. Randall (Dept. Zool., Univ. of Southampton, Southampton, England). 1962. THE RELATIONSHIP BETWEEN HEARTBEAT AND RESPIRATION IN TELEOST FISH. Comp. Biochem. and Physiol. 7(4): 237-250; Biological Abstracts, Vol. 42, No. 6, Abst. No. 21491. 1963.

A tendency for the heart to beat in the mouth-closing phase of the breathing movements is often seen in the resting tench. Synchrony is seldom perfect, except in the anesthetized animal, and disappears if the fish is stimulated in any way. When the breathing movements stop in the tench and other teleosts because of a natural pause, deep anesthestia or curare-induced paralysis, the heart rate decreases. This inhibition of the heart, probably of reflex origin, can also be produced by perfusion of the gills with deoxygenated water and is caused by lack of oxygen at the gills. The breathing movements also appear to have a stimulating effect on the heart rate separate from the oxygen reflex. (Authors)

6306. Sokolov, B. M. 1961. FISH SCALES AS ORGANS OF VISION. (CHESHUYA KAK ORGAN ZRENIYA RYB.) Byul. Nauchn. Tr. Ryazansk. Otd. Vses. Nauchn. Obshch. Anatomov, Gistologov i Embriologov 6. 75-78; Referat. Zhur., Biol., 1962, No. 22I72; Biological Abstracts, Vol. 42, No. 6, Abst. No. 21687. 1963.

A study was made of the anterior portions of scales situated in scale pouches of mirror carp, pike, golden shiner and pike perch. The subject of the experiment (chromatophores in fish scales from different parts of the body) was studied under the microscope. In studying images of the eye seen on the pigmented layers, which form visual screens, the author found similar images (entire fish, their heads, etc.) on the pigmented cells of the scales. This shows that fish possessing cycloid or stenoid scales exhibit bipartition of the organ of vision--a feature which is characteristic of many invertebrates.

6307. Stewart, Kenneth W. (Inst. Fish., Univ. of Brit. Columbia, Vancouver, B. C., Canada). 1962. OBSERVATIONS ON THE MORPHOLOGY AND OPTICAL PROPERTIES OF THE ADIPOSE EYELID OF FISHES. Jour. Fish. Res. Bd. Canada, 19(6): 1161-1162; Biological Abstracts, Vol. 42, No. 6, Abst. No. 21688. 1963.

Observations in Clupea pallasii suggest that the adipose eyelid may affect vision in those fishes which possess it. Two possibilities seem apparent. First, the structure may act as a lens, increasing the focusing power of the eye. Second, it may provide a means by which fish can detect polarized light, at least in the peripheral areas of vision. (B. J. F.)

6308. Follenius, E. (Dept. Appl. Biol., Fac. Sci., Strasbourg, France). 1963. COMPARATIVE STUDY OF THE FINE CYTOLOGY OF THE PREOPTIC NUCLEUS AND OF THE LATERAL TUBERALES NUCLEUS IN THE TROUT (SALMO IRIDEUS GIBB.) AND IN THE PERCH (PERCA FLUVIATILIS). COMPARISON OF THE TWO TYPES OF NEUROSECRETION. (ÉTUDE COMPARATIVE DE LA CYTOLOGIE FINE DU NOYAU PRÉOPTIQUE (NPO) ET DU NOYAU LATÉRAL DU TUBER (NLT) CHEZ LA TRUITE (SALMO IRIDEUS GIBB.) ET CHEZ LA PERCHE (PERCA FLUVIATILIS). COMPARAISON DES DEUX TYPES DE NEUROSÉCRÉTION.) Gen. and Comp. Endocrinol. 3(1): 66-85; Biological Abstracts, Vol. 42, No. 6, Abst. No. 21698. 1963.

A comparative study has been made of the fine structure of the two neurosecretory nuclei of the diencephalon. In the neurons of both nuclei we find a similar arrangement of the various structural features. Two zones may be distinguished in the cytoplasm: a marginal one nearly devoid of all organelles and secretory droplets, but with ergastoplasmic structures (Nissl substance) of varying appearance and importance; and a central one with a well developed endoplasmic reticulum of vesicular type. Numerous mitochondria are found in this zone. The ribonucleoprotein granules abound everywhere between the membranes and on their outer surfaces. The Golgi complex consists of several groups of agranular membranes. Vacuoles, cisternae, and small vesicular elements are seen in each group. Numerous osmiophilic secretory droplets are grouped around the zone of Golgi. The nucleus has a very irregular shape. The cytoplasmic invaginations are enveloped by nuclear lobes. No true nuclear inclusions have been found. The secretory granules arise in the Golgi systems of both the nucleus preopticus (NPO) and the nucleus lateralis tuberis (NLT). A comparison between the preoptic neurosecretory granules and those of the nucleus lateralis tuberis of Salmo irideus shows that the mean maximum diameter of the latter is approximately 30% smaller. Droplets from the NLT are not as osmiophilic in sections as are those from preoptic neurons. The diameters of the secretory droplets do not change during their intraaxonal transport toward the axon endings in the neurohypophysis. Because of this, the hypothesis of a progressive synthesis of the neurosecretory material in the secretory vesicles during transport in the axon cannot be maintained. The neurosecretory neurons of both preoptic and tuber nuclei are in relation with other parts of the nervous system. The presence of typical synaptic structures on these secretory neurons indicates that nerve impulses may intervene in the control of the secretory activity, or that these neurons may be activated and produce nerve impulses. It is also possible that such impulses may control the release of the neurosecretion from the axon endings. (Auth.)

6309. Kondo, Keiichi, and Mitsuru Kitahara. 1962. A NOTE ON SCALES OF THE CHUM SALMON AND ALLIED SPECIES. Bull. Tokai Reg. Fish. Res. Lab. 33. 1-10; Biological Abstracts, Vol. 42, No. 6, Abst. No. 24275. 1963.

One prerequisite for age determination of fish by scale is to use samples obtained with gear having little selectivity of size. Another is to ascertain a range of variations which even the same individuals of fish may have in characters of scales from different positions of the body. The authors studied scale characters of the chum salmon, Oncorhynchus keta, and compared them with those of 4 allied species including the sockeye, O. nerka, the pink, O. gorbuscha, the coho, O. kisutch, and the chinook, O. tschawytscha. The specimens were made available through experimental fishing by the R. V. Tenyô Maru in the northern North Pacific during the 3 summer seasons from 1952 to 1954. Scales of chum and sockeye salmon were taken from 8 positions of the body and examined for shape, the number of ridges and winter zones, and the distance from the focus to the winter zones. The results were compared with the previous examinations of the pink and coho salmon. The study indicated that these scales vary depending upon position on the body, in respect to size, shape and relative length of the winter zones but not to the number of the zones. Analyses of variances of fork lengths of the chum salmon were carried out to verify age determination based on the scale reading. Among the samples provided from both drift nets and long lines, significant difference of fork length, depending more on age categories than on any other factor, was established in the present study. Scale characters compared with each other of the 5 Pacific salmon were found applicable for the purpose of species identification. (Authors)

6310. Reshetnikov, Iu. S. 1961. ON RELATIONS BETWEEN THE NUMBER OF GILL RAKERS AND THE FEEDING HABITS OF CHARS OF THE GENUS SALVELINUS. (O SVYAZI MEZHDU KOLICHESTVOM ZHABERNYKH TYCHINOK I KHARAKTEROM PITANIYA U GOL'TSOV RODA SALVELINUS.) Zool. Zhur. 40(10): 1574-1577; Referat. Zhur. Biol., 1962, No. 7I20; Biological Abstracts, Vol. 42, No. 6, Abst. No. 24279. 1963.

Age variability of the number of gill rakers

and pyloric appendices shows the number of the latter to continuously increase with the growth of fish, and the final number of gill rakers to be formed in young fishes when they attain the length of 120-130 mm. The number of gill rakers is determined by the character of feeding of the young, while that of pyloric appendices is determined by the character of feeding of adult fishes. (Auth.)

6311. Neal, Richard A. (Fish. Res. Inst., Univ. of Washington, Seattle). 1963. BLACK AND WHITE CRAPPIES IN CLEAR LAKE, 1950-1961. Iowa State Journal of Science, Vol. 37, No. 4, pp. 425-445.

Catches of crappies in Clear Lake, Iowa, indicated a shift in populations from one predominantly black, Pomoxis nigromaculatus (Le Sueur) from 1948-56, to one predominantly white, Pomoxis annularis Rafinesque, in 1961. This shift appears to be associated with increased turbidity and with decreased water levels. During this period the mean condition factors for white crappies have remained fairly constant while those for black crappies have declined steadily. The growth rates of the two species, as indicated by the Hile index, were negatively correlated, but, in neither species was the growth correlated with annual temperatures or water levels. Black crappies seem to inhabit inshore water more than white crappies. Year class strength did not show great variation, as is sometimes reported for crappies. (Auth.)

6312. Sneed, Kermit E., and Howard P. Clemens (Southeastern Fish Cultural Lab., Bur. Sport Fish. & Wildl., Marion, Alabama). 1963. THE MORPHOLOGY OF THE TESTES AND ACCESSORY REPRODUCTIVE GLANDS OF THE CATFISHES (ICTALURIDAE). Copeia, 1963, No. 4, pp. 606-611.

The testes of catfishes (Ictaluridae) are lobate and not compact, solid-appearing glands as in most warm-water fishes. The posterior one-fourth of the testis is reduced and retains a pink color throughout the year, but the anterior three-fourths becomes progressively larger and whiter as the spawning season approaches. Microscopic examination revealed that the anterior three-fourths of the gland contained cuboidal (spermatogenic) cells in various stages of division, while cysts of the posterior lobes were lined with columnar epithelium. The cells in the posterior lobes increased in size as the spawning season approached; however, it was demonstrated that secretions from this region are not essential to viability of sperm nor to the normal development of ova.

The testes of the white catfish (Ictalurus catus) are somewhat different from those of other members of the family examined. (Authors)

6313. Wyatt, Ellis J. (Central Oregon Coll., Dept. of Biol., Bend), and Ivan Pratt. 1963. MYXOBOLUS INSIDIOSUS SP. N., A MYXOSPORIDIAN FROM THE MUSCULATURE OF ONCORHYNCHUS TSHAWYTSCHA (WALBAUM). The Journal of Parasitology, Vol. 49, No. 6, pp. 951-955.

Spring chinook salmon fingerlings from the Oregon State Fish Commission hatcheries on the South Santiam River in Linn County and the McKenzie River in Lane County were found to be infected with Myxobolus insidiosus sp. n. Cysts and vegetative stages were found in the body musculature. Free spores were found in the gill capillaries, kidney, liver, and spleen. Some infected fish exhibited slightly swollen circular areas upon the body, which are devoid of scales, as well as frayed fins and tails. (Authors)

6314. Weatherley, A. H. (Zool. Dept., School of General Studies, Australian National Univ., Canberra, Australia). 1963. THERMAL STRESS AND INTERRENAL TISSUE IN THE PERCH PERCA FLUVIATILIS (LINNAEUS). Proceedings of the Zoological Society of London, Vol. 141, Part 3, pp. 527-555.

Experiments indicate 30-31° C as the upper thermal limit for perch since, irrespective of the level of their temperature acclimatization, they cannot survive hotter conditions for more than a few hours. Perch that were gradually heated in lethal temperature tests indulged in agitated exploratory behavior as they neared their lethal levels of temperature. Just below the lethal, balance and coordination became seriously impaired, and the final phases of activity were marked by violent and disoriented swimming.

Among other changes, atrophy of the interrenal tissue accompanied exposure to various levels of temperature. These changes were related to severity of thermal stress, being most marked when high temperature was prolonged during acclimatization at 28-30° C, when hyperplasias could also occur, or when temperature was raised rapidly to exceed the animal's thermal tolerance in lethal tests. At moderately high temperatures it sometimes appeared that interrenal cell hypertrophy could take place. Changes in other tissues--viz. renal tubules, head kidney, liver, muscle--generally only occurred at the higher levels of prolonged exposure. While the changes varied in character between tissues all are considered essentially degenerative, and due to some kind of breakdown of the body's normal defenses against stress.

To test the postulated function of interrenal tissue in combating various forms of stress, perch were chilled, made anoxic, and placed in diluted sea water, as well as heated. These experiments, with others in which perch received mammalian ACTH (both to test its general histological effects and in an attempt to influence lethal temperature) indicate an important function for interrenal tissue in offsetting stress.

It is tentatively suggested that the complex of histological changes observed considerably resembles that of the "General-Adaptation-Syndrome" of mammals, that most of the histological changes are due to either adaptive or maladaptive adjustments of the perch's organ systems or tissues, and

that interrenal tissue occupies a similar functional position in the perch to that of adrenocortical tissue in mammals in opposing stress, including the stress of heat. (Auth.)

6315. Weatherley, A. H. (Zool. Dept., School of General Studies, Australian National University, Canberra, Australia). 1963. ZOOGEOGRAPHY OF PERCA FLUVIATILIS (LINNAEUS) AND PERCA FLAVESCENS (MITCHILL) WITH SPECIAL REFERENCE TO THE EFFECTS OF HIGH TEMPERATURE. Proceedings of the Zoological Society of London, Vol. 141, Part 3, pp. 557-576.

Perch, Perca fluviatilis and P. flavescens, are limited in their distribution by hills and mountains, being unable to persist in streams in which the rate of water flow is rapid. This fact largely determines the pattern of their world distribution. However, evidence is adduced to show that in North America and Australia high temperatures may be acting in determining the proximity of their approach to the equator. In contrast, perhaps, to some species it is believed that perch do not avoid death from high temperature by active avoidance of unfavorable thermal conditions, but that high temperature acts fairly directly in imposing limits. Because perch spawn in the spring, while conditions are still fairly cool, it is thought that high temperature is unlikely to affect reproduction adversely. (Auth.)

6316. Chubb, James C. (Dept. of Zool., The Univ. of Liverpool, Liverpool, England). 1963. ON THE CHARACTERIZATION OF THE PARASITE FAUNA OF THE FISH OF LLYN TEGID. Proceedings of the Zoological Society of London, Vol. 141, Part 3, pp. 609-621.

The salmon Salmo salar, trout S. trutta, gwyniad Coregonus clupeoides pennantii, grayling Thymallus thymallus, pike Esox lucius, roach Rutilus rutilus, eel Anguilla anguilla, and perch Perca fluviatilis from Llyn Tegid have been examined, and 28 species of parasites were found. The relationship of the parasite fauna to the environment is discussed; it is concluded that the combination of available host species and the degree of specificity of the available species of parasites will be the factors responsible for the inclusion or exclusion of a parasite from an environment. It is suggested it is possible to characterize the parasite fauna of an aquatic environment; if a species of host is typical for the environment, then its parasites are also typical for this same environment. Thus, it is proposed that for Llyn Tegid the parasites of the Salmonoidei are the oligotrophic element of the parasite fauna, while the parasites of the pike, roach and perch are the eutrophic element. The parasites of the eel form a separate component of the parasite fauna, while certain other species of parasites may occur in lakes of all types. It is stressed that just as there is a diversity and individuality of lakes, so also will there be diversity and individual variation of the constituent parasite faunas. (Auth.)

6317. U. S. Dept. of Health, Education, and Welfare (Public Health Serv., Div. of Water Supply & Pollution Cont., Washington, D. C.). 1962. NATIONAL WATER QUALITY NETWORK. ANNUAL COMPILATION OF DATA, OCTOBER 1, 1961 - SEPTEMBER 30, 1962. Public Health Service Publication No. 663, 909 pp.

This is the fifth annual compilation of data from the National Water Quality Network of the Public Health Service. During this year the Network was increased from 93 to 122 stations. The data have revealed interesting findings, particularly with respect to synthetic organic chemicals such as insecticides and pesticides, in our surface waters. Sufficient data have been accumulated to define trends in certain areas, such as radioactivity. (From Foreword)

6318. Dragovich, Alexander, John H. Finucane, John A. Kelly, Jr., and Billie Z. May (Bur. Comm. Fish. Biol. Lab., Galveston, Texas). 1963. COUNTS OF RED-TIDE ORGANISMS, GYMNODINIUM BREVE, AND ASSOCIATED OCEANOGRAPHIC DATA FROM FLORIDA WEST COAST, 1960-61. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 455, 40 pp.

This report presents counts of the red-tide organisms, Gymnodinium breve, and associated oceanographic data for the period from January 1960 to August 1961. Methods of collecting and analyzing samples are mentioned. Data on water temperature, water transparency, light transmission, cloud type, cloud amount, visibility, sea direction, sea state, wind direction, wind force, salinity, inorganic phosphate phosphorus, total phosphate phosphorus, nitrate-nitrite nitrogen, ammonia, total organic and inorganic nitrogen, silicon, calcium, and alkalinity are presented. These data were collected as a part of a study on the distribution and incidence of G. breve and related ecological conditions and extend the records reported in a previous paper from 1959 to 1961. (Authors)

6319. Junge, Charles O., Jr., and Lloyd A. Phinney (Fish. Res. Inst., Coll. of Fish., Univ. of Washington, Seattle). 1963. FACTORS INFLUENCING THE RETURN OF FALL CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) TO SPRING CREEK HATCHERY. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 445, 32 pp.

This preliminary study is primarily concerned with a definition of the problems that must be considered in isolating the factors influencing the relatively high survival rates of chinook salmon (Oncorhynchus tshawytscha) at Spring Creek Hatchery, Washington. The tabulation and study of basic data relating to the distribution of egg take, releases of fry and fingerlings, and adult returns were the first steps in this analysis.

An index of production based on female returns adjusted for the effects of the Columbia River gill

net fishery was related to the releases of fry and fingerlings which had been spawned 4 years earlier. Returns for the brood years 1941-49 were first investigated, since construction completed for the 1950 brood altered the available facilities at Spring Creek Hatchery. A multiple correlation coefficient of 0.891 ($P<0.01$) gave indication of a reasonably consistent relationship between releases of fry and fingerlings (in pounds) and subsequent returns. A correlation of 0.890 between returns and fingerlings releases only gave strong evidence that variations in return were controlled almost entirely by fingerling releases. Some qualification of this result is necessary since in 1948 and 1949 at the time when large numbers of fry were released into the Columbia River, water temperatures in the river were near freezing in contrast to the constant temperature of 46° F of Spring Creek water. It is highly probable that such a temperature differential could induce mortalities.

When the study is extended to more recent years it is apparent that survival rates since 1950 have been greatly reduced. When the pounds of fingerlings released are taken into consideration, even the large returns in 1958 and 1959 do not exhibit survival rates comparable to those maintained in the 1940's. Factors coincident with this reduction are considered--incidence of tuberculosis and coagulated yolk disease, increased crowding of fingerlings, and change in diet.

In light of the findings of the present study, additional studies are proposed. (Authors)

6320. Switzer, C. M. 1961. CONTROL OF AQUATIC WEEDS. Res. Rep. E. Sect. Nat. Weed Cttee, Canada, 105-14; Weed Abstracts, Vol. 12, No. 1, Abst. No. 167. 1963.

Fenoprop at 2-4 ppm suppressed most species of Potamogeton, the potassium salt formulation appearing slightly more effective than the ester. Paraquat at 3 ppm controlled Potamogeton foliosus, but had no effect on Chara spp. In 1 trial, good top-kill of Agrostis sp. and Spartina pectinata was obtained with Urab (fenuron trichloroacetate) liquid at 12.5, 25 and 50 gal per ac. In trials with endothal, 100% kill of P. pectinatus, P. amplifolius, P. natans, Ceratophyllum sp. and Spirogyra spp. (algae) was obtained at rates of 1-3 ppm and 90% kill of Cladophora spp. was obtained at 2 ppm. Chara spp., Nuphar sp. and Brasenia sp. were resistant. Aqualin (acrolein 85%) at 3 and 6 ppm, applied by a power sprayer discharging under the water surface, gave satisfactory kill of Chara spp., though some regrowth was noted two weeks after treatment; regrowth was widespread in plots treated with doses of 1.5 ppm. White suckers and several minnow species were killed by Aqualin at 6 ppm at the time of application. The effect of TD-47 (endothal analogue) at 0.25-0.5 ppm and Aqualin at approximately 6.0 ppm on the alga Cladophora was variable; control was reduced by low water temperatures at the time of treatment. In trials with 2, 4-D granular, a rate of 100# applied by means of a whirl-plate spreader mounted on a boat, gave good control of dense stands of Elodea sp., Vallisneria sp., Ludwigia sp., Myriophyllum sp. and fanwort (presumed Ceratophyllum sp.). In another trial, Kurosal G (fenoprop potassium 20%) at 2 ppm fenoprop, controlled P. illinoensis and P. richardsonii and gave 60% control of Utricularia vulgaris and P. pectinatus. Kurosal SL. (7.2 lb per gal fenoprop potassium) at 2 ppm fenoprop reduced the stand of P. illinoensis by 75% and at 4 ppm gave >90% control of P. illinoensis, P. richardsonii and P. zosteriformis and 75% suppression of P. pectinatus. Kuron (4.8 lb fenoprop propylene glycol butyl ether ester per gal) at 2 ppm gave 75-90% control of P. illinoensis, P. pectinatus, Pontederia cordata and Scirpus validus. Esteron 99 Granules (2, 4-D propylene glycol butyl ether ester 20%) at 2 ppm 2, 4-D, gave 90% control of P. richardsonii and at 4 ppm gave 90% control of P. illinoensis and S. validus.

6321. Smith, G. 1962. EURASIAN WATERMILFOIL (MYRIOPHYLLUM SPICATUM) IN THE TENNESSEE VALLEY. Proc. 15th Southern Weed Conf., 258-264; Weed Abstracts, Vol. 12, No. 1, Abst. No. 171. 1963.

The origin and extent of infestations of M. spicatum in the Tennessee Valley, its growth habits, methods of propagation, and its noxious effects are described. Using tractors to drag loops of barbed wire through infested areas gives only temporary control and may further its spread. In tests during 1960 and 1961 in water averaging approximately 8 ft. in depth, granular 2, 4-D butoxy ethanol ester was very effective on the 6 plots tested and liquid fenoprop on the one plot tested. The feasibility of control by de-watering is discussed. Exclusion of light by means of a black polyethylene cover killed the plants in 72 days, but not in 21 days.

6322. Houser, A., and J. Y. Gaylor. 1962. RESULTS OF ENDOTHAL AND TWO FORMULATIONS OF SILVEX FOR THE CONTROL OF AQUATIC PLANTS IN OKLAHOMA. Proc. 15th Southern Weed Conf., 244-253; Weed Abstracts, Vol. 12, No. 1, Abst. No. 173. 1963.

When applied in whole ponds, granular endothal at 2 ppm gave 100% control of Najas guadalupensis, Potamogeton pectinatus and Ceratophyllum; at 1 ppm it gave only 80% control of N. guadalupensis and C. demersum, but was completely effective against Nelumbo lutea. Plot treatments were generally less effective. Liquid endothal was as effective as the granular and easier to handle. Neither formulation at 2 ppm controlled Chara sp., Typha latifolia or Scirpus sp. The liquid at 0.5 ppm + fenoprop 1.5 ppm and spreader-sticker gave complete control of N. guadalupensis, Potamogeton nodosus, C. demersum, Polygonum sp. and Jussiaea repens.

In tests during 1960, liquid fenoprop (potassium salt) at 1 ppm controlled N. guadalupensis throughout the year in one pond and only 30% regrowth had occurred by late July the following year. In one test at 1.5 ppm it controlled Zannichellia palustris,

P. nodosus and C. demersum. After treatment with 2 ppm, C. demersum showed no regrowth and N. guadalupensis developed only minor regrowth in one pond and none in two other tests. In the 1961 tests, 2 ppm gave seasonal control of N. guadalupensis, P. nodosus, P. pusillus, Polygonum sp., C. demersum, J. repens and (in one trial only) Nuphar sp. No control of Chara sp. was obtained and control of T. latifolia and Eleocharus sp. was inconsistent. Granular fenoprop (potassium salt) seemed to require a rate of 100# to give results comparable with 2 ppm of the liquid. Results from a propylene glycol butyl ether ester formulation of liquid fenoprop were unsatisfactory.

Treatments made before plants began fruiting appeared to give more conclusive results than later applications. The alkalinity of the water appeared to have no influence on the results. None of the treatments caused mortality to fish and there were no reports of off-flavor in fish flesh.

6323. Thomaston, W. W. 1962. RESULTS OF EXPERIMENTAL WEED CONTROL EXPERIMENTS IN GEORGIA FARM PONDS USING SIMPLIFIED GRAVITY FLOW TECHNIQUES. Proc. 15th Southern Weed Conf., 234-243; Weed Abstracts, Vol. 12, No. 1, Abst. No. 175. 1963.

The results are reported of preliminary trials in which the following gravity flow methods of application were used: (1) chemical diluted in a container in the boat and thrown out over the weed beds as the boat moved along; (2) partially diluted chemical thrown in pond from the bank; (3) applied undiluted directly in water as the boat moved over the weed beds. Distribution of the herbicide was apparently effected by the water currents. In Georgia farm ponds, all three methods produced comparable results, which were equal to or superior to spraying. The following consistent results were obtained: Nymphaea sp., Nuphar sp., Myriophyllum brasiliense, M. heterophyllum, Brassica sp., Utricularia sp. and Nymphoides sp. were controlled by chlorophenoxy herbicides (fenoprop, 2, 4, 5-T ester, MCPA, 2, 4-D amine and ester) at 1 gal/ac (3.34-4 lb a.e./gal) applied as a total pond treatment. Fenoprop controlled Eleocharis acicularis at 2 ppm; lower concentrations gave erratic results. Chlorophenoxy herbicides controlled Chara sp. and Najas sp. at 1 ppm in limited experiments, but failed to control Lemna sp. at 2 ppm by either gravity flow or spray methods. Diesel fuel oil sprayed at 50 gal/ac and sodium arsenite applied by gravity flow at 2.4 ppm controlled Lemna sp. Granular herbicides were no more effective than liquid.

6324. Seaman, D. E., and W. A. Porterfield (Plantation Field Lab., Fort Lauderdale, Florida). 1962. FEASIBILITY OF CONTROLLING AQUATIC WEEDS WITH SNAILS. Proc. 15th Southern Weed Conf., 256-257; Weed Abstracts, Vol. 12, No. 1, Abst. No. 176. 1963.

In preliminary experiments in 200-gal tanks with Marisa cornuarietis, a fresh-water snail of South American origin, plants placed in separate tanks with 150 snails per half tank compartment were eaten in the following order of rapidity: Ceratophyllum demersum > Najas guadalupensis > Potamogeton illinoensis = Salvinia rotundifolio = Eichhornia crassipes > Pistia stratiotes > floating Alternanthera philoxeroides > submerged A. philoxeroides. The snails also readily ate Cabomba caroliniana and filamentous algae such as Pithophora, Spirogyra and Mougeotia. Very little damage was done to 3- and 4-week-old cultivated rice by snails having no other source of food. Younger rice plants and germinating rice seed did not survive in the presence of Marisa snails.

In a 3-plant experiment, C. demersum and S. rotundifolia were completely eaten and submerged; A. philoxeroides defoliated within 5 days by 200 snails per tank. When 7 plants were placed together with 200 snails per tank for 25 days the following order of edibility was observed: N. guadalupensis > P. illinoensis > S. rotundifolia > C. demersum > submerged A. philoxeroides. The first four were completely eaten, but the fifth only partly. P. stratiotes and E. crassipes, especially the latter, gained in weight during the period.

Marisa populations of 50, 100, 200, and 400 per half tank all failed to eradicate E. crassipes, but all populations were effective in inhibiting growth and flowering; their principal action was root pruning.

S. rotundifolia was eradicated by populations of 50, 100 and 200 snails per half tank. A density of 4 or 5 snails per cu. ft. of water is thought to be feasible for control under natural conditions in southern Florida.

Cassidix mexicanus, a common bird of Florida, is an important feeder on Marisa. Dense blooms of phytoplankton, composed mainly of the alga Polycystis, were apparently responsible for severe snail kills.

6325. Cortell, J. M. (Allied Biol. Control Corp., Boston, Massachusetts). 1961. PROGRESS REPORT ON THE FIELD TESTING OF VARIOUS HERBICIDES FOR AQUATIC WEED CONTROL. Proc. N. East. Weed Control Conf., 15, 532-538; Weed Abstracts, Vol. 12, No. 2, Abst. No. 510. 1963.

In a preliminary trial, Acrolein (acrylaldehyde) at 3 ppm gave 100% kill of Utricularia purpurea and of filamentous algae and 90-100% control of Potamogeton natans, but poor control of Nymphaea odorata, Nuphar advena, and Brasenia schrebei and no control of Polygonum pennsylvanicum. Endothal liquid at 3-5 ppm and granular at 2 ppm gave 90-100% control of P. natans, P. oaksianus and P. robbinsii, but only 30-60% control of Polygonum sp., Nuphar sp. and Nymphaea sp.; the liquid gave 100% control of Utricularia sp., but the granular only 60%.

Fenoprop acid at 1 ppm, iso-octyl ester at 0.5 ppm and a granular formulation of the acid at 50# all gave 100% control of Myriophyllum heterophyllum; the granular at this rate also gave 100% control of Nymphaea sp., Nuphar sp., and Ceratophyllum

demersum and 80% control of U. purpurea, whereas the liquid formulations were less effective against these species. Three treatments in August at 4-day intervals with the liquid fenoprop acid at 1 ppm gave 95% control of Elodea canadensis with no fish kill and no undesirable odors or tastes.

Esteron 99 (2, 4-D) granular at 50# gave 100% control of M. heterophyllum, 80% control of Nymphaea sp., 60% of Nuphar sp., 70% of C. demersum and no control of P. natans. In one test only, simazine granular (no rate given) gave 80% control of P. pennsylvanicum.

6326. Bolster, C. L. 1961. SUMMARY OF AQUATHOL TEST RESULTS. Proc. N. East. Weed Control Conf., 15, 563-565; Weed Abstracts, Vol. 12, No. 2, Abst. No. 511. 1963.

The following recommendations are given for both granular and liquid formulations of Aquathol (endothal-disodium): for Zannichellia spp., Ceratophyllum spp., Potamogeton diversifolius, P. natans, P. pusillus, and P. pectinatus 1-2 ppm for entire pond or large-area treatment (L. A. T.) or 2-3 ppm for lake margin or spot treatment (S. T.); for Heteranthea spp., Myriophyllum spp., P. americanus, P. amplifolius, P. filiformis, and P. zosteriformis 2-3 ppm (L. A. T.) and 304 ppm (S. T.); for Naias spp. and P. crispus 0.5-1.5 ppm (L. A. T.) and 2-3 ppm (S. T.); for Sparganium spp. 3-4 ppm. (L. A. T.) and 4-5 ppm (S. T.); and for Wolffia, Spirodela and Lemna spp., surface contact spray at 5 gal/ac liquid Aquathol. In northern areas, Pithophora, Cladophora and Spirogyra algae appear susceptible to 2-5 ppm, though regrowth may develop. Owing to its slower diffusion rate, the granular is preferable to the liquid for spot treatment. Treatment during early growth when water temperatures have reached 62-65° F is recommended. Application in extremely cold waters is not effective.

6327. Noll, D. C., and R. Budrick (North Jersey District Water Supply Comm., Wanaque, New Jersey). 1961. INTERIM REPORT ON AQUATIC WEED CONTROL OF RECREATIONAL WATERS ABOVE POTABLE WATER. Proc. N. East. Weed Control Conf., 15, 470-475; Weed Abstracts, Vol. 12, No. 2, Abst. No. 512. 1963.

An account is given of the experimental application of fenoprop at 1 and 2 ppm to two lakes which overflowed into a water supply reservoir and of the effects on the quality of the water. Tests in two laboratories using the same method of analysis indicated the absence of phenols, while a third laboratory using a different method of analysis found phenols present in some of the samples. The development of a reliable standard procedure for analysis is strongly recommended.

It is recommended that where herbicides are applied in similar conditions (1) the lake water should be drawn down below the spillway sufficiently to give a month's detention before refilling, (2) experienced herbicide applicators are necessary and that these should be examined and licensed by the State, and (3) the lake should be divided into sections for treatment as a precaution against possible fish kill.

6328. Burdick, G. E. (New York State Conservation Dept., Albany). 1961. CHEMICAL CONTROL OF AQUATIC VEGETATION IN RELATION TO THE CONSERVATION OF FISH AND WILDLIFE. Proc. N. East. Weed Control Conf., 15, 485-492; Weed Abstracts, Vol. 12, No. 2, Abst. No. 514. 1963.

A general examination of the subject with discussion of the vegetation requirements of fish, the toxicity levels of some herbicides, and research needs and procedures.

6329. Simes, J. C. (Pennsylvania Fish Comm., Harrisburg). 1961. CONTROL OF THE POND WEED, POTAMOGETON CRISPUS, IN BOTH FLOWING AND STATIC SITUATIONS WITH ENDOTHAL. Proc. N. East. Weed Control Conf., 15, 558-559; Weed Abstracts, Vol. 12, No. 2, Abst. No. 515. 1963.

In a pond with no inflow or outflow and an average temperature of 65° F, endothal at 3 ppm gave 100% control of P. crispus (but no control of Anacharis canadensis, Lemna minor, or filamentous algae). In four ponds with an inflow averaging 10 gpm and a temperature at treatment time (June) of 55-60° F, P. crispus was controlled 100% by endothal at 5 ppm and approximately 65% by 1 ppm, with no significant difference between liquid and granular formulations. A pond receiving the outflow of these 4 ponds and 4 lower ponds supplied by the receiving pond were also well cleared of P. crispus. In two more ponds, P. crispus was controlled 100% by 3 ppm of liquid and granular endothal. In all ponds which received a constant inflow of water (resulting in a complete change of water in approximately 6 days) regrowth of P. crispus by the end of September averaged 5% for ponds treated with 5 ppm and 40% for 1 ppm.

Application of 5 ppm to a section of a trout-rearing raceway with a flow of 3.2 gpm resulted in complete control one month later for a distance of about 1/4 mile and partial control for an additional 600 ft.

There was no indication of fish injury in any of the tests.

6330. Horrocks, A. W., and R. F. Smith. 1961. CONTROL OF EURASIAN MILFOIL, MYRIOPHYLLUM SPICATUM, IN LAKE HOPATOONG, NEW JERSEY. Proc. N. East. Weed Control Conf., 15, 549-557; Weed Abstracts, Vol. 12, No. 2, Abst. No. 516. 1963.

Heavy infestations of M. spicatum were successfully controlled by lowering of the lake water level in winter to expose plants in shallow areas to freezing, and by application in May of 2, 4-D granules at 20# a.i. The operation is described in detail. Neither Potamogeton amplifolius nor Vallisneria americana was controlled, and the latter invaded the cleared areas.

The treatment appreciably reduced water

clarity. A few of the samples of water analyzed indicated the presence of phenols in sufficient quantities to affect the taste of the water. There was no evidence of fish kill.

6331. Timmons, F. L. 1962. THE STATUS AND PROSPECTS IN AQUATIC WEED CONTROL. Proc. 19th Western Weed Control Conf., 59-64; Weed Abstracts, Vol. 12, No. 3, Abst. No. 757. 1963.

The results are given of a nation-wide survey initiated in September 1961 to inquire into the extent of weed infestation of ponds, ditches, canals and lakes in the U. S. A. Work on aquatic weed control since 1900, using mechanical methods and herbicides, is reviewed and a consensus of preferred methods of controlling the various types of aquatic weed is given. A herbivorous fish, Tilapia mossambica, has given excellent control of submersed aquatic weeds in Hawaii and a fresh-water snail, Marisa cornuarietis, has given promising control of submersed and floating weeds in Puerto Rico and Florida. A low-growing species of water-plantain, Alisma gramineum, appears to compete successfully with rank-growing pondweeds in irrigation canals.

6332. Lindaberry, H. L. 1961. CONSIDERATIONS REGARDING THE USE OF AQUATHOL IN POTABLE WATERSHEDS. Proc. N. East. Weed Control Conf., 15, 481-484; Weed Abstracts, Vol. 12, No. 3, Abst. No. 758. 1963.

Information is given on the aquatic species susceptible to disodium endothal (Aquathol), its rate of disappearance, and its toxicity to fish, rats and man.

6333. Castellanos, P. C. (Lake Supervisor, Lake Mohawk, New Jersey). 1961. AQUATIC WEED CONTROL AND RELATED PROBLEMS AT LAKE MOHAWK, NEW JERSEY. A PRIVATE LAKE COMMUNITY. Proc. N. East. Weed Control Conf., 15, 524-531; Weed Abstracts, Vol. 12, No. 3, Abst. No. 759. 1963.

Potamogeton crispus has been kept under control by the application of sodium arsenite at 5 ppm at the beginning of May before emergence of the weed, with retreatment after about May 20 of any area where plants have developed. The method of application (from boats) is described. Analysis of samples has indicated no build-up of arsenical residues following 10 years of application. The destruction of P. crispus has given rise to heavy growth of algae, which are controlled by running off the top water and by dichlone. An invasion of Myriophyllum spicatum was eradicated by Kuron (fenoprop low-volatility esters) at 2 ppm applied in August. The disadvantages of lowering the lake for weed control are discussed.

6334. Simes, J. C. 1961. POTENTIAL USES OF CALCIUM CYANAMID IN THE CONTROL OF AQUATIC VEGETATION. Proc. N. East. Weed Control Conf., 15, 561-562; Weed Abstracts, Vol. 12, No. 3, Abst. No. 760. 1963.

When ponds and raceways were emptied and scraped and then treated in mid-June with calcium cyanamid at 100 lb/1000 sq. ft. and with calcium hypochlorite and chlorine, before being refilled 2-14 days later, the calcium cyanamid kept the waters virtually weed-free until at least the end of October, whereas weed removal was necessary by early September following the calcium hypochlorite and chlorine treatments. When applied to a small pond without inflow or outflow, calcium cyanamid at 50 lb/1000 sq. ft. killed all animal life (fathead minnows, polliwogs and insects) and 90% of aquatic plants, including Lemna minor, but gave only temporary control of filamentous algae; the water was no longer toxic to the minnows 1 month later. No control of any weeds was obtained by applying calcium cyanamid at 100 lb/1000 sq. ft. to a raceway with a flow of 2.5 cu. ft. /sec.

6335. Pierce, M. E. (Vassar Coll., Poughkeepsie, New York). 1961. PROGRESS REPORT ON THE EFFECT OF KURON APPLICATIONS AFTER ONE AND TWO YEARS AT LONG POND, DUTCHESS COUNTY, NEW YORK. Proc. N. East. Weed Control Conf., 15, 545; Weed Abstracts, Vol. 12, No. 3, Abst. No. 761. 1963.

Spraying with Kuron (fenoprop low-volatile esters), in area (a) at 2 ppm in 1958 and with 1.2 ppm in 1959, and in area (b) at 0.8 ppm in 1957 and at an unknown concentration in 1958, kept area (a) free of the surface Nymphaea sp., Nuphar sp. and Pontederia sp. and area (b) free of Nymphaea sp. until at least the summer of 1960. At this time Utricularia sp. remained reduced in both areas, but submerged Potamogeton amplifolius and P. natans were flourishing in area (a).

6336. Pierce, M. E. (Vassar Coll., Poughkeepsie, New York). 1961. A STUDY OF THE EFFECT OF THE WEED-KILLER 2, 4-D AQUA GRANULAR ON SIX EXPERIMENTAL PLOTS OF LONG POND, DUTCHESS COUNTY, N. Y. Proc. N. East. Weed Control Conf., 15, 539-544; Weed Abstracts, Vol. 12, No. 3, Abst. No. 762. 1963.

2, 4-D granular at 0.9-3.6 ppm, applied to the pond on June 29, eliminated Nymphaea odorata and Brasenia sp. at all concentrations. Utricularia purpurea and Chara sp. were reduced but not eliminated by concentrations of 1.8 ppm upwards. The moss Drepanocladus was entirely resistant. Diffusion of the granules was negligible. Plankton population was only temporarily reduced; benthic forms were not affected, and neither apparently were fish, frogs or turtles. Data on water temperature, pH and dissolved oxygen content is included.

6337. Hiltibran, R. C. (Natural History Survey, Urbana, Illinois). 1961. AQUATIC WEED CONTROL RESEARCH IN CENTRAL ILLINOIS. Res. Rep. 18th N. Cent. Weed Control Conf., 102-103; Weed Abstracts, Vol. 12, No. 4, Abst. No. 1032. 1963.

Endothal-disodium at 1 ppmw was toxic to Potamogeton crispus, P. foliosus and P. pectinatus,

the latter of which was resistant to sodium arsenite. Ceratophyllum demersum and Myriophyllum spp. were controlled by endothal at 3-5 ppmw. Liquid and granular endothal applied to P. crispus at 1 ppmw were equally effective; neither formulation was effective on Dianthera americana or Jussiaea diffusa, but both were effective on Sagittaria latifolia at 25 ppmw. The floating leaves of P. nodosus and P. vaseyi largely disappeared after applying a solution of 50 ml endothal in 1 gal water. Neither liquid nor granular endothal at 5 ppmw was effective on Cabomba caroliniana.

Diquat was effective on P. pectinatus and P. foliosus at 1 ppm and on P. crispus at 2 ppmw, but not on M. exalbescens at 1 ppmw, Najas flexilis 2 ppmw, C. caroliniana 3 ppmw, N. gracillima 4 ppmw and Elodea canadensis and Ranunculus spp. 3-4 ppmw. A solution of 50 ml diquat (4 lb/gal) in 0.5 gal water killed S. latifolia and reduced the stand of D. americana by 80-90%. 2, 4-D iso-octyl ester granular at 3 ppmw, 2, 4-D dimethylamine 5 ppmw and fenoprop propylene glycol butyl ether (PGBE) ester 2 ppmw controlled M. exalbescens.

Mixed butyl and isopropyl esters of 2, 4-D and fenoprop PGBE ester both at rates of 50 ml of a 4 lb/gal solution in 0.5 gal water and 20% granular formulations of 2, 4-D and fenoprop iso-octyl esters were effective against Scirpus acutus, S. latifolia and D. americana applied at 1 lb/400 sq. ft. The granular iso-octyl esters of 2, 4-D, 2, 4, 5-T and fenoprop were ineffective against Ranunculus spp., C. caroliniana, N. flexilis and N. gracillima. Dalapon sodium at 4 oz/gal, amitrole at 2 oz/gal and mixed butyl and isopropyl esters of 2, 4-D at ml/gal controlled Typha latifolia and T. angustifolia. Adding a wetter improved the effectiveness of the herbicides.

6338. Guse, L. R. (Dept. Bot., Univ. of Purdue, Lafayette, Indiana). 1961. AQUATIC WEED CONTROL RESEARCH IN INDIANA. Res. Rep. 18th N. Cent. Weed Control Conf., 102; Weed Abstracts, Vol. 12, No. 4, Abst. No. 1033. 1963.

Algae. Diquat at 5 ppmw gave satisfactory control of Spirogyra spp., Hydrodictyon spp., Oscillatoria spp., Anabaena spp., Cladophora spp. and Chara spp. Endothal sodium granular at 3 ppmw and simazine wettable powder at 5 ppmw controlled Chara vulgaris.

Submerged weeds. Potamogeton spp., Myriophyllum spp., Ceratophyllum spp. and Elodea spp. were controlled by fenoprop potassium at 2 ppmw, endothal sodium at 1-4 ppmw., diquat at 5 ppmw and 2, 4-D ester at 3 ppmw. Control with simazine wettable powder was erratic, while that with the granular formulation was generally satisfactory. Ametryne at 4 and 5 ppmw gave satisfactory control of submerged species, but caused irritation to or the death of some fish.

Emergent species. Dalapon at 20 lb and amitrole at 10 lb, both in 100 gal water, continued to give effective control of Typha spp., Juncus spp. and Phragmites spp. Phalaris arundinacea was controlled by amitrole-T at 1 gal in 100 gal water and dalapon at 20 lb in 100 gal water. Fenoprop, fenoprop potassium and 2, 4-D controlled Nymphaea spp. Satisfactory control of duckweeds (Wolffia spp., Spirodela spp. and Lemna spp.) was obtained only with 2-amino-3-chloro-4-naphthaquinone at 10#.

6339. Mackenthun, K. M. (Aquatic Nuisance Control Cttee on Water Pollution, Madison, Wisconsin). 1961. OBSERVATIONS ON THE USE OF 2, 4-D GRANULES IN FISH HATCHERY PONDS. Res. Rep. 18th N. Cent. Weed Control Conf., 103; Weed Abstracts, Vol. 12, No. 4, Abst. No. 1035. 1963.

2, 4-D granules at 25-30# applied to parts of 3 Delafield State fish hatchery ponds decomposed a luxuriant growth of well-developed pondweeds, consisting principally of Ranunculus sp., Ceratophyllum sp. and Potamogeton spp. 8 weeks after treatment, without causing harmful effects to the fish present.

6340. Steucke, E. W. (Cttee on Water Pollution, Lake Mills Nat. Fish Hatchery, Wisconsin). 1961. OBSERVATIONS ON THE USE OF DISODIUM ENDOTHAL IN FISH HATCHERY PONDS. Res. Rep. 18th N. Cent. Weed Control Conf., 104; Weed Abstracts, Vol. 12, No. 4, Abst. No. 1036. 1963.

Endothal-disodium at 2 ppm liquid and granular gave good control of Myriophyllum spp., Ceratophyllum spp. and Chara spp. 1-2 weeks after treatment, without affecting either the fish population, which included largemouth bass, bluegill and both adult and juvenile goldfish, or the fish food organisms present. The only significant change in the ponds after treatment was an increase in the level of carbon dioxide and a lowering of the pH. A rapid knockdown of vegetation, followed by slow decay, did not create any oxygen deficiency. Upon submersion, the granules of endothal-disodium attached themselves to the leaves and stems of the submerged vegetation. The early knockdown of the pondweeds enabled ponds to be treated and drained within 3 to 4 days.

6341. Silver, Stuart J., Charles E. Warren, and Peter Doudoroff (Pacific Cooperative Water Pollution and Fish. Res. Lab., Oregon State Univ., Corvallis). 1963. DISSOLVED OXYGEN REQUIREMENTS OF DEVELOPING STEELHEAD TROUT AND CHINOOK SALMON EMBRYOS AT DIFFERENT WATER VELOCITIES. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 327-343.

Embryos of steelhead trout, Salmo gairdneri gairdneri Richardson, and chinook salmon, Oncorhynchus tshawytscha (Walbaum), were reared from fertilization of the eggs to hatching at different constant oxygen concentrations and water velocities. For this purpose, an apparatus was developed that makes it possible to control oxygen concentration independently of water velocity, which was maintained at levels ranging from 6 to 1,350 centimeters per hour. Measurements of the embryos and hatched fry indicate that water velocities must be high enough not only to transport enough oxygen to

the redd for supplying the total requirement of all embryos, but also to deliver sufficient oxygen to the surface of the chorion enveloping the individual embryo. Steelhead embryos held at 9.5° C and chinook salmon embryos held at 11° C all died at an oxygen concentration of 1.6 mg/l. Survival of large percentages of embryos reared at concentration as low as 2.5 mg/l was apparently made possible by reduction of respiration rates and consequent reduction of growth and development rates. Sac fry from embryos reared at low and intermediate oxygen concentrations were smaller and weaker than sac fry from embryos reared at high concentrations. Although weak sac fry may survive under laboratory conditions, they cannot be expected to do so in nature. The size of steelhead trout and chinook salmon fry at hatching probably was dependent on water velocity even at velocities as high as 740 and 1,350 cm/hr, respectively, and on oxygen concentration even at concentrations near saturation levels. Mean size differences among embryos reared under different conditions at the higher velocity and oxygen-concentration levels were not great, particularly in the case of the steelhead trout. (Authors)

6342. Knight, Alexis E. (Lamar National Fish Hatchery, Lamar, Pennsylvania). 1963. THE EMBRYONIC AND LARVAL DEVELOPMENT OF THE RAINBOW TROUT. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 344-355.

Photographs of the developing rainbow trout, Salmo gairdneri Richardson, are presented in sequence from the initial cleavage through hatching. Approximately 3,000 eggs were incubated in standard hatchery troughs supplied with spring water at a constant temperature of 54° F. Accepted fish cultural methods were followed to insure normal developmental patterns. Samples of these eggs were taken for study at 1-hour intervals from the 5th to the 24th hour after fertilization; then once every 6 hours until they were 72 hours old; then at 1-day intervals through the peak of hatching on the 23rd day. The embryos were fixed in 5 percent neutral formalin containing 0.95 percent sodium chloride, stained in Harris' hematoxylin, and photographed with a vertically mounted camera. (Auth.)

6343. Carroll, Billy B., Gordon E. Hall (Tenn. Valley Authority, Norris, Tennessee), and Robert D. Bishop. 1963. THREE SEASONS OF ROUGH FISH REMOVAL AT NORRIS RESERVOIR, TENNESSEE. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 356-364.

Norris Reservoir was not fished commercially prior to 1958. Experimental fishing in the winter of 1958-59 yielded 91,060 pounds of rough fish, with indications of sufficient numbers of catfishes, carp, carpsuckers, drum, and paddlefish of suitable size to support a limited commercial fishery. Commercial netting by contract the following winter yielded only 39,517 pounds, even though the total netting effort was 1.4 times greater than in 1958-59. In fall and winter 1960, with still greater daily netting effort, only 13,396 pounds were harvested. The catch per thousand yards of net of the dominant species--paddlefish, flathead catfish, carpsuckers, and carp--declined in the three seasons from approximately 25 to 9 fish and from 322 to 63 pounds. The average weight of all paddlefish caught dropped from 57.2 to 37.4 pounds, and of flathead catfish from 22.6 to 14.7 pounds. Carpsuckers, carp, drum, and other less valuable species were still available in quantity but were not harvested because of the low profit margin. It is recommended that commercial fishing for paddlefish and flathead catfish be allowed every 3 to 5 years, with less valuable rough species being removed continually by state crews or by commercial fishermen receiving some form of subsidy.

The 3-inch-mesh trammel net proved to be the most effective gear for taking merchantable-sized rough fishes. Capture of game fishes was negligible, amounting to only 1 percent of the total catch by weight. (Authors)

6344. Ashley, Laurence M., and John E. Halver (U. S. Fish and Wildl. Serv., Western Fish Nutrition Lab., Cook, Washington). 1963. MULTIPLE METASTASIS OF RAINBOW TROUT HEPATOMA. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 365-371.

A case of multiple metastasis in a hepatomatous rainbow trout, with metastases to eight different organs, is reported. All metastases were confirmed by histopathologic examination. Tumor emboli were found in branchial vessels in the apices of gill filaments. This case was one of 14 hepatomatous rainbow trout among which the incidence of metastasis was 30 percent. (Authors)

6345. Lemke, Armond E., and Donald I. Mount (U. S. Dept. of Health, Education, and Welfare, Robt. A. Taft Sanit. Engng. Ctr., Cincinnati, Ohio). 1963. SOME EFFECTS OF ALKYL BENZENE SULFONATE ON THE BLUEGILL, LEPOMIS MACROCHIRUS. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 372-378.

Three 30-day bioassays were conducted using alkyl benzene sulfonate (ABS) formulations as the toxic agent. Duplicate groups of 10 bluegills (Lepomis macrochirus) were exposed to a series of concentrations in a continuously renewed solution. The 30-day median tolerance limit (TL_m) ranged between 15.5 and 18.3 ppm of active ingredient. The difference between the 24-hour and the 30-day TL_m ranged between 6.5 and 0.5 ppm. Subsequent to exposure, swimming performance tests and histological procedures were conducted on the test fish. A reduction of growth rate in one test and histological changes in all tests were evident at concentrations approximately one-third of the TL_m value. Tests of swimming performance were negative. Test fish exhibited some degree of acclimation to ABS after exposure to sublethal concentrations. (Authors)

6346. Ward, F. J., and L. A. Verhoeven (International Pacific Salmon Fish. Comm., New Westminster, B. C., Canada). 1963. TWO BIOLOGICAL STAINS AS MARKERS FOR SOCKEYE SALMON FRY. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 379-383.

Neutral red and Bismarck brown Y were tested as immersion stains for sockeye salmon fry. Although initial mortalities were low in experiments using Neutral red, all fry regardless of concentration or immersion time were dead on the 4th day. Controls survived well. Three experimental groups of fry stained in Bismarck brown Y solutions were conspicuously stained after a week, and total mortalities were low during 7- and 13-day holding periods. (Authors)

6347. Buchholz, Marvin M., and Kenneth D. Carlander (Iowa State Univ., Ames, Iowa). 1963. FAILURE OF YELLOW BASS, ROCCUS MISSISSIPPIENSIS, TO FORM ANNULI. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 384-390.

Failure to form annuli in certain years was noted in the analysis of age and growth data for yellow bass collected from Clear Lake, Iowa, from 1952 through 1959, when the yellow bass were slow-growing. Lack of fish in the 1950 and 1951 year classes permitted detection of the failure of the abundant 1949 year-class fish to form annuli in 1955, 1956, 1957, and 1958. The 1946, 1948, and 1952 year classes also were shown to have missed annulus formation in some of the same years. The fourth annulus of the 1952 year class was not formed until late 1956 or early 1957, and age VI yellow bass of this year class showed only four annuli. Many scales also showed lateral resorption in 1956-58. Failure of annulus formation in slow-growing fish of several species is believed to be more common than reported, but difficult to detect. Finding of age IX yellow bass (with five annuli, however) extends the known life span of this species. (Authors)

6348. Cooper, Edwin L. (Pennsylvania State Univ., University Park), Herbert Hidu, and John K. Andersen. 1963. GROWTH AND PRODUCTION OF LARGEMOUTH BASS IN A SMALL POND. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 391-400.

The relationships among standing crop, growth, and surplus production of largemouth bass were studied in a fertile 2.8-acre pond in central Pennsylvania. A few adult bass were permitted to spawn naturally in 1958 and 1960, and the resulting populations were observed during their second years of life. Initial standing crops of the yearling bass (20,043 in 1959 averaging 3.4 inches long; 5,490 in 1961 averaging 5.2 inches long) were reduced by harvesting in both years. Growth and condition of the yearling bass were measured in the two years concurrently with the harvesting. Poor condition and slow growth of the bass occurred together with a high standing crop in 1959; in 1961, a lower standing crop was accompanied by both a higher condition factor and faster growth. Surplus production of yearling bass was greater in 1961 (75.5 pounds per acre) when fewer fish were present, than it was in 1959 (51.0 pounds per acre). The increased production in 1961 was expressed in fewer fish of a much larger average size (8.4 inches in 1961; 4.0 inches in 1959), a circumstance considered to be more favorable to the pond owner. (Authors)

6349. Gross, W. L., P. O. Fromm, and E. W. Roelofs (Dept. of Fish. & Wildl. and Physiol. & Pharmacol., Michigan State Univ., East Lansing). 1963. RELATIONSHIP BETWEEN THYROID AND GROWTH IN GREEN SUNFISH, LEPOMIS CYANELLUS (RAFINESQUE). Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 401-408.

The effect of thyroid activity on growth of green sunfish and the influence of photoperiod on thyroid activity were investigated. Fish and three thyroidal levels were held in light-tight aquaria at constant temperatures under four photoperiods (8-hour constant, 16-hour constant, variable increasing 8-16 hours, and variable decreasing 16-8 hours). Differences in growth of fish given injections of thyroxine (hyperthyroid), radioiodine (hypothyroid), and saline solution (control) demonstrated that the hyperthyroid fish attained the greatest growth and hypothyroid fish the least growth. Increased food consumption and increased efficiency of food conversion were generally associated with greater thyroid activity and/or greater availability of thyroxine. Using rate of loss of radioiodine from the head region as an index of thyroid activity, it was found that greater thyroid activity was associated with short photoperiods and low thyroid activity with long photoperiods. (Authors)

6350. Rothschild, Brian J. (U. S. Bur. Comm. Fish., Biol. Lab., Honolulu, Hawaii). 1963. A CRITIQUE OF THE SCALE METHOD FOR DETERMINING THE AGE OF THE ALEWIFE, ALOSA PSEUDOHARENGUS (WILSON). Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 409-413.

A critical evaluation of the annulus as an index of age in fresh-water populations of the alewife has been made. Features of the alewife scale are described. Measurements of annulus position and agreement of ages estimated by the scale method with ages estimated from length-frequency distributions suggest the validity of the annulus as a criterion for estimating alewife age. (Auth.)

6351. Wolfert, David R. (U. S. Bur. Comm. Fish., Sandusky, Ohio). 1963. THE MOVEMENTS OF WALLEYES TAGGED AS YEARLINGS IN LAKE ERIE. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 414-420.

A total of 3,998 yearling walleyes, Stizostedion vitreum vitreum (Mitchill), were captured, tagged, and released along the south shore of western Lake Erie to determine their movements and their dispersal from a known nursery area. Four hundred

ninety-nine recoveries were made over a period of 3 years. Tagged walleyes traveled primarily north toward the islands in the Western Basin during their first year of liberation, and in succeeding years moved progressively toward the extreme western end of the lake. Some walleyes were recaptured within 6 months in the Detroit River, Lake St. Clair, the St. Clair River, and southern Lake Huron, and the percentage of fish recaptured in these waters north of Lake Erie increased annually. Movement eastward into the Central and Eastern Basins of the lake appeared negligible. The greatest distance traveled by a marked walleye was 236 miles. The average distance traveled by all tagged fish was 25 miles. (Auth.)

6352. Bridges, W. R., B. J. Kallman, and A. K. Andrews (Bur. Sport Fish. & Wildl., Fish-Pesticide Res. Lab., Denver, Colorado). 1963. PERSISTENCE OF DDT AND ITS METABOLITES IN A FARM POND. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 421-427.

A farm pond near Morrison, Colorado, was treated with 0.02 ppm of DDT in June 1961. The persistence and distribution of the insecticide in materials sampled from the aquatic environment were studied until November 1962. Detectable amounts of DDT were not found in the water after 3 weeks. Residues in the mud had declined within 8 weeks after the treatment to levels not significantly higher than pre-treatment levels, but a sample of vegetation still contained relatively high levels of residues. From this time until the second summer, sufficient vegetation was not present to provide a sample for chemical analysis. A new crop of vegetation sampled 1 year after the treatment contained residues approximating pre-treatment levels. Fish accumulated 3 to 4 ppm of DDT and its metabolites within 1 month after the treatment. The residue levels slowly declined after this, but when the study was terminated, 2 to 3 ppm of the metabolites DDD and DDE still remained in the fish. The highest residue levels measured in crayfish were about one-half of those found in fish. Some mortality of the more susceptible fish and invertebrates occurred as a result of the DDT treatment; however, severe adverse effects were not demonstrated. (Authors)

6353. Muncy, Robert J., and Abe D. Oliver, Jr. (Louisiana State Univ., Baton Rouge). 1963. TOXICITY OF TEN INSECTICIDES TO THE RED CRAWFISH, PROCAMBARUS CLARKI (GIRARD). Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 428-431.

Toxicities to the red crawfish were determined for 10 insecticides considered for use in controlling the forest tent caterpillar or being used to control rice and sugar cane insects. Malathion, dimethoate, and Mirex were not toxic to crawfish at concentrations effective in large-scale insect control projects. The seven insecticides found to be toxic to crawfish, listed in order of the lowest 24-hour and 72-hour median tolerance limits (TL_m), were methyl parathion, endrin, DDT, sevin, Bidrin, Dibrom, and phosphamidon. Methyl parathion was found to remain toxic in water to crustaceans for over 1 month. Bidrin and phosphamidon were effective in controlling the forest tent caterpillar in extensive forested areas at levels approximately 100 times lower than the 24-hour TL_m for red crawfish. (Authors)

6354. Shell, E. W. (Agri. Experi. Sta., Auburn Univ., Auburn, Alabama). 1963. EFFECTS OF CHANGED DIETS ON THE GROWTH OF CHANNEL CATFISH. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 432-434.

Four groups of channel catfish utilized in a protein requirement experiment were immediately started on a new experiment to determine the amount of food needed by channel catfish for most efficient conversion. The groups of catfish were fed a commercial trout pellet at the rate of 2.5, 5.0, 7.5, or 10.0 percent of body weight per day. At the end of a two-week period, the growth rates were compared with the growth rates these same fish attained during the last two weeks of the protein requirement experiment. The results of this study confirmed previously reported findings that the growth of fish on a new diet may be influenced by the previous diet. The catfish that grew slowly on the low protein, purified diets showed an increase in their growth rate when placed on the trout pellets. The catfish on the high protein diets grew at a slower rate when placed on the trout pellet diet and the degree of reduction in growth was inversely related to growth rates on the purified diets. No explanation can be given for the phenomenon and additional research is suggested.

6355. Borgeson, David P. (Inland Fish. Br., California Dept. of Fish and Game, Sacramento). 1963. A RAPID METHOD FOR FOOD-HABITS STUDIES. Transactions of the American Fisheries Society, Vol. 92, No. 4, pp. 434-435.

A time-saving method for a volumetric and numerical analysis of food habits of fishes is described.

6356. International North Pacific Fisheries Commission (Vancouver, B. C., Canada). 1963. ANNUAL REPORT 1961. International North Pacific Fish. Comm., 127 pp.; Biological Abstracts, Vol. 44, No. 1, Abst. No. 72. 1963.

Report of the 8th annual meeting of the Commission held at the Ministry of Foreign Affairs, Tokyo, Japan. Results of that meeting, and of future planned work and research are given. There is an administrative report, a list of participants, and reports of research work by Canada, Japan, and the United States in 1961.

6357. Pfeiffer, W. (Sept. Zool., Univ. British Columbia, Vancouver, B. C., Canada). 1963. ALARM SUBSTANCES (IN FISH, REVIEW). Experientia 19(3): 113-123; Biological Abstracts, Vol. 44, No. 1, Abst. No. 429. 1963.

6358. Bé, Allan W. H. (Lamont Genol. Observatory, Columbia Univ., Palisades, New York). 1962. QUANTITATIVE MULTIPLE OPENING-AND-CLOSING PLANKTON SAMPLERS. Mar. Sci. Instrumentation 1: 156-162; Biological Abstracts, Vol. 44, No. 1, Abst. No. 490. 1963.

Two quantitative opening-and-closing plankton samplers are described for serial sampling of zooplankton in the upper 1000 meters of water. The Multiple Plankton Sampler (MPS) is designed for towing at three depth ranges (0-100 m; 100-250 m; and 250-500 m) in the upper 500 meters, and the Bathypelagic Sampler (BPS) is intended for simultaneous towing in the more sparsely populated 500-1000 m depths. (Auth.)

6359. Lewis, William M., O. D. McNail, and R. C. Summerfelt (Coop. Fish. Res. Lab., Southern Illinois Univ., Carbondale). 1963. A DEVICE FOR TAKING WATER SAMPLES IN STERILE BOTTLES AT VARIOUS DEPTHS. Ecology 44(1): 171-173; Biological Abstracts, Vol. 44, No. 1, Abst. No. 504. 1963.

The device described and illustrated consists of a frame with a solenoid mounted above a rack for holding a sample bottle mount below. An extension of the armature of the solenoid connects to the stopper of a sample bottle. A spring is mounted on the extension of the armature. When the solenoid is energized it removes the stopper from the sample bottle. When the solenoid is de-energized the spring in the armature replaces the stopper. The solenoid is powered by two 6-volt, dry cell batteries wired in series. Functioning of the solenoid is controlled by two switches. One switch gives full amperage for opening the sampler and the other gives reduced amperage sufficient to keep the sample bottle open until it fills. The sampler is particularly suited to bacteriological studies. (Authors)

6360. Marshall, N. B. (Brit. Mus. (Nat. Hist.), London, England). 1962. THE BIOLOGY OF SOUND-PRODUCING FISHES. In: Symposium on Biological Acoustics, 1961. Symposia Zool. Soc. London 7. 45-60; Biological Abstracts, Vol. 44, No. 1, Abst. No. 506. 1963.

Fishes may make (incidental) sounds as they swim or by emitting gas bubbles from the swim bladder. Special sound-making structures appear to be confined to the Teleostii, which produce sounds by stridulation, by vibration of the swim bladder wall and by sudden movements of the head. Swimming sounds may lead to responses by predators (or prey) and they seem to be involved in schooling behavior. Gas bubble sounds appear to be without biological significance. Stridulatory sounds are generated by friction between neighboring parts of the skeleton, those made by the pharyngeal teeth often inducing resonant response in the swim bladder. Direct means of eliciting swim bladder sounds are by way of special drumming muscles, which in certain catfishes are associated with an elastic spring mechanism. Contractions of nearby parts of the axial musculature and pectoral fin movements (certain trigger fishes) may also lead to sound production by the swim bladder. Swim bladder sounds tend to be lower in pitch than those due to stridulation. Quick head movements (in Bathygobius and certain blennies) give rise to sharp thumping sounds. A great many fresh-water fishes, most of which belong to the order Ostariophysi, are auditory "specialists": they have some form of linkage between the swim bladder and the inner ears. This accessory auditory channel enhances their hearing capacities, but little is known of the part played by sound in their lives. Numerous catfishes produce sounds (by stridulation or by vibration of the swim bladder wall) which could be an important means of assembling the sexes in turbid waters. Cyprinid fishes (Notropis spp. and related kinds) are particularly vocal during the breeding season. Sounds may be uttered during fighting (among males) and during courtship, and it seems likely that they are used as signs of recognition among species and as a means of isolating the sexes. There is anatomical and acoustical evidence that many of the shelf-dwelling marine fishes produce sounds. Studies are now beginning to reveal the biological roles of sound. Those made by the pharyngeal teeth may lead to feeding activities (and attract predators or alert prey). Sounds are certainly associated with aggressive display and mating activities, and, most likely, with recognition of species and territorial behavior. Sounds are also prevalent in the deep ocean. Anatomical studies, which are still in progress, indicate that the rat-tailed fishes must be conspicuous producers of sound. Swim bladder drumming muscles appear to be confined to the males. Means of communication (and perhaps of echo-sounding) would seem to be particularly important in the deep sea environment. (Auth.)

6361. Höhnk, W. (Edited by.) 1963. PUBLICATIONS OF THE INSTITUTE OF OCEANOLOGY IN BREMERHAVEN. SUPPL. THIRD MARINE BIOLOGICAL SYMPOSIUM, OCTOBER 23-25TH, 1962, IN BREMERHAVEN. (VEROEFFENTLICHUNGEN DES INSTITUTS FUR MEERESFORSCHUNG IN BREMERHAVEN. SONDERBAND. DRITTES MEERESBIOLOGISCHE SYMPOSION 23. BIS 25. OKTOBER 1962 IN BREMERHAVEN.) Maps. Institut fur Meeresforschung: Bremerhaven, Germany; Biological Abstracts, Vol. 44, No. 1, Abst. No. 525. 1963.

This symposium (in German) is divided into 5 parts. (A) Biology of Animals at the Sea Bottom; (B) Evolutionary Questions of Marine Interest; (C) Studies on Behavior; (D) Open Discussion; (E) Reports. Titles of papers in A are: Recent Ideas on the Origin of Deep Sea Fauna; The Sea Bottom as a Colonization Place for Plants and Animals; Chemical Changes on the Sea Bottom; Biological Effect of Increased Water Pressure--Experimental Deep Sea Physiology; The Effect of Salt Content on the Various Life Processes of the Bony Fish Cyprinodon macularius; Thermal Relationships in the

Deeper Water of the Sea; Fungi in the Sea; Data and Preliminary Deliberations on the Distribution of Bacteria in the North Sea; Distribution of Fish Species in the North Sea During the Summer of 1959 and 1960 and During the Winter of 1961-62; The Water Mixing Processes at the Mouth of the Weser and Elbe; Studies of the Fauna at the Bottom of the North Sea in German Waters and Studies of Folliculinides (Ciliata: Heterotricha) in German Waters. Papers from part B are: Variations of Biological Development in the Sea and in Fresh Water; Studies of the Morphogenesis of the Radula of Gastropods; Experimental Observations of the Effect of External Factors on the Development of the Hydrozoa and Discussion of their Significance to Evolution; Evolutionary Phenomena in Bony Fish, Considered Genetically. Papers in part C are: The Biological and Evolutionary Significance of Fish Colonies; Study of Marine Bioacoustics; Natural Eye and Egg Lures in Fish: Intraspecific Function of Body Coloration. The discourse of part D is: Recent Observations of the Origin of the Ocean. Reports in part E include: Some Marine Biological Equipment Abroad; The Excursion with the Research Ship "Victor Hensen" to the Tegeler Plate and Eversand; Excursion Through the Wurster Swamp. An index of those participating in this symposium is given. (J. G. S.)

6362. Hoffman, Dale Arthur. 1962. THE CONCENTRATION AND ACCUMULATION OF RADIOACTIVE PHOSPHORUS BY AN AQUATIC FOOD CHAIN. Dissert. Absts. 23(1): 364-365; Biological Abstracts, Vol. 44, No. 1, Abst. No. 562. 1963.

6363. McDonald, Donald Burt. 1963. THE PRODUCTIVITY OF DEER CREEK RESERVOIR, UTAH, WITH SPECIAL REFERENCE TO THE PHYTOPLANKTON. Dissert. Absts. 23(6): 3092-3093; Biological Abstracts, Vol. 44, No. 1, Abst. No. 568. 1963.

6364. Schmulbach, James C. (Dept. Zool., State Univ. of South Dakota, Vermillion), and Hollace A. Sandholm. 1962. LITTORAL BOTTOM FAUNA OF LEWIS AND CLARK RESERVOIR. Proc. South Dakota Acad. Sci. 41: 101-112; Biological Abstracts, Vol. 44, No. 1, Abst. No. 578. 1963.

Chironomids were numerically and volumetrically the most important organisms taken in Lewis and Clark Reservoir, constituting 87.0 and 40.1% of the total number and volume of organisms respectively. The oligochaetes were volumetrically the second most important benthic organisms, comprising 27.8% of the total volume of organisms. Oligochaetes were found at all depths but had a tendency to prefer water over 1 meter in depth. They were also more abundant on quiet bottoms having considerable organic debris. The large mayfly, Hexagenia rigida, was important volumetrically contributing 20.8% to the total volume. This species was found primarily in sampling areas with soft silt bottoms at the 1 and 3 meter depths. The water boatmen, Sigara sp., constituted 1.9 and 5.7% of the total number and volume of organisms, respectively, and were most abundant in the 10 centimeter samples. Ceratopogonids appeared to favor the shallow water and were taken more frequently in 10 centimeter samples. Fluctuations in water caused by normal operation of the reservoir did not seem to deplete or seriously affect organisms at the 10 centimeter sampling areas. Even when those areas became exposed to the atmosphere, organisms either survived in the moist soil or emigrated from the area, but were found in "normal" numbers after these areas were reinundated. Some organisms also may have immigrated to the 10 centimeter areas after reinundation. Although there were few studies on reservoirs to which the present study may be compared, the standing crop of bottom organisms appeared to be rather small in Lewis and Clark Reservoir. Perhaps this is not surprising in view of the fact that there is a complete exchange of water through the reservoir every 8 to 10 days. The results of the investigation indicate the need for an extensive, long-term study on the bottom fauna of Lewis and Clark Reservoir. (Authors)

6365. Verduin, Jacob (Biol. Dept., Bowling Green State Univ., Bowling Green, Ohio). 1963. RADIOACTIVITY OF SUSPENSOIDS IN AQUATIC HABITATS OF NORTHWESTERN OHIO. Ohio Jour. Sci. 63(1): 39-43; Biological Abstracts, Vol. 44, No. 1, Abst. No. 583. 1963.

Gross beta radioactivity of suspensoids in ponds, streams and a lake was compared with phytoplankton volume. No positive correlation was evident, although the suspensoids contained from 12 to 23 times more radioactivity per gram (avg. 370 μμc/g) than was present in the dissolved solids. It is concluded that radioactive particles in fallout from weapons tests either are adsorbed on suspensoids, alive or dead, or are themselves sufficiently large to be held on the millipore filters used to collect these samples. (Auth.)

6366. Biostatistical Section (California Dept. Fish and Game, Terminal Island). 1963. THE CALIFORNIA MARINE FISH CATCH FOR 1961. Calif. Dept. Fish and Game, Fish Bull. 121. 1-47; Biological Abstracts, Vol. 44, No. 1, Abst. No. 591. 1963.

The 1961 commercial fish catch is arranged in 18 tables by months, statistical areas, and major ports. Additional tables record common and scientific names, value of each species to the fishermen, number of licensed fishermen by area of residence, and number of fishing boats by length. Sport catch from 1936 to 1961, and live bait catch for 1961, comprise the final two tables. (S. P. D.)

6367. Bodenstein, G., and G. Müller-Bastgen. 1960. INVESTIGATIONS ON THE TOXICITY OF SOME HERBICIDES FOR FISHES. (UNTERSUCHUNGEN ÜBER DIE TOXIZITÄT EINIGER HERBIZIDE FÜR FISCHE.) Zeit. Pflanzenkrankheiten 67(3): 150-153; Biological Abstracts, Vol. 44, No. 1, Abst. No. 592. 1963.

Among a number of chemical and hormone

herbicides (2, 4-trichlorophenoxy-acetic-acid, o-isoprophyl-M-3-chlorophenol-carbamate (CIPC), 3-(p-chlorophenyl) -1, 1-dimethylurea (CMU)) tested in the laboratory, only CIPC and to a certain extent CMU proved to be dangerous for fish. (H. H.)

6368. Cooley, Richard Allen. 1962. DECLINE OF THE ALASKA SALMON. A CASE STUDY IN RESOURCE CONSERVATION POLICY. Dissert. Absts. 23(2): 686-687; Biological Abstracts, Vol. 44, No. 1, Abst. No. 594. 1963.

6369. Dahl, Jørgen (Danmarks Fiskeri- og Havundersg., Charlottenlund, Denmark). 1962. STUDIES ON THE BIOLOGY OF DANISH STREAM FISHES. I. THE FOOD OF GRAYLING (THYMALLUS THYMALLUS) IN SOME JUTLAND STREAMS. Meddel. Danmarks Fisker. Og Havundersg. 3 (7/12): 199-264; Biological Abstracts, Vol. 44, No. 1, Abst. No. 596. 1963.

A total of 520 grayling stomachs was examined from 6 streams between 1944 and 1954. Essentially the grayling exploits the bottom fauna irrespective of the habitat. The food varies greatly with the season of the year and these variations are correlated mainly with fluctuations in populations of the food organisms. The variety of food organisms eaten is great. Most important are amphipods, gastropods, Ephemeroptera nymphs, Trichoptera larvae and pupae, and Simulium larvae. In three populations studied there were considerable differences in stomach contents from the source of organic drift, from which it can be concluded that air-borne food, especially that of terrestrial origin, acts as emergency food where the natural supply from bottom or drift of aquatic origin is insufficient. No differences were found between males and females. There was considerable difference in food from day to day, apparently due to weather conditions affecting consumption, but sampling gear and station locality also affected assessment of food available. There were also variations in feeding habits for similar seasons from year to year. Older grayling tend to feed more exclusively on bottom fauna, and grayling tend to keep in schools of individuals of similar ages, each occupying stream sections providing the most suitable feeding conditions. In one river there appeared to be a relationship between fish size and food size but this relationship could not be established elsewhere. (D. V. E.)

6370. Hughes, Janice S. (Louisiana Wild Life and Fish. Comm., Monroe), and James T. Davis. 1963. VARIATIONS IN TOXICITY TO BLUEGILL SUNFISH OF PHENOXY HERBICIDES. Weeds 11 (1): 50-53; Biological Abstracts, Vol. 44, No. 1, Abst. No. 607. 1963.

The toxicity of 3 to 21 commercial formulations of 2, 4-dichlorophenoxyacetic acid (2, 4-D), 2, 4, 5-trichlorophenoxyacetic acid (2, 4, 5-T), 2-(2, 4-dichlorophenoxy)-propionic acid (2-(2, 4-DP)), and 2-(2, 4, 5-trichlorophenoxy) propionic acid (silvex) to Lepomis macrochirus was determined. The variations among formulations of the same herbicide were much greater than those among different herbicides. Variations in toxicity of a single formulation were also noted. Formulations of each herbicide were reported as either safe or unsafe for aquatic applications. Amine salts were generally less toxic to fish than esters. The formulation selected for use should be assayed prior to field application, using the receiving water. (Authors)

6371. Kutkuhn, Joseph H. (U. S. Bur. Comm. Fish., Galveston, Texas). 1963. ESTIMATING ABSOLUTE AGE COMPOSITION OF CALIFORNIA SALMON LANDINGS. Calif. Dept. Fish and Game Fish Bull. 120. 1-42; Biological Abstracts, Vol. 44, No. 1, Abst. No. 613. 1963.

A description of catch age structure is needed to evaluate mortality in fished salmon stocks. Study of age composition data from California king (chinook) salmon landings suggests that the double sampling technique can provide efficient estimates of the total number of salmon comprising each age group represented. In this technique, samples for age are drawn systematically from carefully defined length strata. Efficiency increases as the costs of determining age increase relative to those of measuring length. It is shown, however, that unless an age determination costs at least five times a length measurement, simple random (direct) sampling for age alone is as good a technique as double (indirect) sampling and is far less complex computationally. For salmon taken commercially from any of 5 coastal subareas and during any month of the season (port-month), analysis indicates that future age samples should consist of at least 200 specimens, temporally well-distributed and representing no less than eight 5-cm. length strata. A fixed schedule would be impractical but sampling for age should be somewhat heavier in the upper (80 cm. and larger) length strata. A cluster sampling technique involving port-area and month strata is also applied to obtain and assess the precision of estimated totals in each age group annually entering all coastal landings combined.

6372. Larimore, R. Weldon, and Philip W. Smith (Illinois Nat. Hist. Surv., Urbana). 1963. THE FISHES OF CHAMPAIGN COUNTY, ILLINOIS, AS AFFECTED BY 60 YEARS OF STREAM CHANGES. Ill. Nat. Hist. Surv. Bull. 28(2): 299-375; Biological Abstracts, Vol. 44, No. 1, Abst. No. 615. 1963.

Three surveys of the fishes of Champaign County (modal years 1899, 1928, and 1959) permitted an evaluation of changes that occurred over a 60-year period, during which much of the county was converted from marshy prairie to well-drained farmland. Recent intensive farming and urbanization were preceded by (1) drainage activities that lowered the water table, eliminated natural marshes and ponds, and caused extreme fluctuations in flow; (2) dredging and canalization that altered stream courses and produced more uniformity in the stream environment; and (3) pollution that severely affected, or eliminated, the

aquatic communities in some areas. Of the 90 species of fishes recorded for Champaign County, 74 were taken in 1959 or subsequently. Seven of the 90 were introduced species; the remaining 83, some of them no longer found in the county, were native. Over the 60-year period of study, 16 species showed a decided increase in the percentage of stations and stream systems in which they were found, whereas at least 15 other species showed a decided decrease. Many species showed little change in occurrence, despite great changes that took place in the stream habitats. Much greater changes in species composition of streams occurred during the first 30 years spanned by the studies than during the second 30 years. The average number of species per collecting station and the average number of fish per 100 square yards of water were somewhat greater in 1959 than in 1928, perhaps as a result of differences in collecting efficiency. Several generalizations about fish distribution and stream size, suggested by authors of the 1928 investigations, were borne out in the 1959 study: The number of species per station increased downstream; the actual number of fish per unit area decreased downstream; with a decrease in the number of individuals downstream, there was a corresponding increase in the average size, so that the total weight of fish per unit area was nearly constant. The amount of stream pollution increased during the 60-year period. The large and increasing volume of sewage effluents limited aquatic life in many areas of Champaign County streams at the time of the third survey. The streams were found to be enriched by natural soil fertility and a variety of introduced substances. Although certain fish populations in 1959 were benefiting from this enrichment, slight changes in chemical balance and concentration were found to convert enriched areas quickly into polluted ones. In 1959 Champaign County contained a considerable amount of water useful for fishing; approximately 20 of the 90 species of fishes known in the county were commonly taken by angling. The streams also provided a good source of bait minnows. (Authors)

6373. Larkins, Herbert A. (U. S. Bur. Comm. Fish., Seattle, Washington). 1963. COMPARISON OF SALMON CATCHES IN MONOFILAMENT AND MULTIFILAMENT GILL NETS. Commercial Fish. Rev. 25(5): 1-11; Biological Abstracts, Vol. 44, No. 1, Abst. No. 616. 1963.

An experiment designed to compare the Pacific salmon catches of monofilament and multifilament gill nets was conducted in 1962 by the U. S. Bureau of Commercial Fisheries on board the research vessel "Bertha Ann". Monofilament gill nets of 2 1/4 inch and 4 1/2 inch mesh were inserted in the normal multifilament net string and the catches of the two types were analyzed in terms of number of fish, length, age, and species composition. The effect of monofilament nets on adjacent multifilament nets was also tested. In general, the monofilament greatly outfished the multifilament and took the same lengths and ages of salmon as the multifilament although the species composition differed. The presence of monofilament apparently reduced the salmon catch of adjacent 3 1/4 inch multifilament nets. (Auth.)

6374. Mulla, M. S. (Dept. Entomol., Univ. of California, Riverside), L. W. Isaak, and H. Axelrod. 1963. FIELD STUDIES ON THE EFFECTS OF INSECTICIDES ON SOME AQUATIC WILDLIFE SPECIES. Jour. Econ. Entomol. 56(2): 184-188; Biological Abstracts, Vol. 44, No. 1, Abst. No. 624. 1963.

The effect of 29 insecticides at multiple dosages in the field was studied on the mosquito fish Gambusia affinis (Baird and Girard). This fish is considered one of the most important predators of immature stages of mosquitoes. At mosquito larvicidal rates, 11 experimental compounds plus naled (formerly known as Dibrom), methyl parathion and ronnel were nontoxic to the fish; the remaining 10 experimental materials plus Guthion (O,O-dimethyl S-(4-oxo-1, 2, 3-benzotriazin-3-(4H)-ylmethyl) phosphorodithioate), ethyl Guthion (O, O-diethyl S-(4-oxo-1, 2, 3-benzotriazin-3(4H)-ylmethyl)phosphorodithiate), Guthion (O, O-diethyl S-(4-oxo, 1, 2, 3-benzotriazin-3(4H)-ylmethyl) phosphorodithioate), diazinon, parathion, and carbophenothion (formerly designated Trithion) manifested varying degrees of toxicity. Eighteen materials were tested against pollywogs (aquatic larval stages) of the bullfrog Rana catesbeiana, western toad Bufo boreas, and Hammond's spadefoot toad Scaphiopus hammondi. Of the 11 materials tested against the first named species, Bayer 38920 (6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-3-methyl-6, 9-methano-2, 4-benzodioxepin) (at 0.5 and 2.0 pounds per acre), carbophenothion (at 0.4 and 1.6 pounds per acre) and GC-3582 (O,O-diethyl-1-(2, 5-dichlorophenyl)-2, 2-dichlorovinyl phosphate) (at 1.6 pounds per acre) were highly toxic. The remaining six experimental materials plus naled and ethyl Guthion were nontoxic to this species. The seven materials including parathion, Guthion, methyl parathion, ronnel and three experimental compounds tested against B. boreas and S. hammondi were all nontoxic for 24 hours after application. (Authors)

6375. Vincent, Robert Earl. 1963. BIOGEOGRAPHICAL AND ECOLOGICAL FACTORS CONTRIBUTING TO THE DECLINE OF ARCTIC GRAYLING, THYMALLUS ARCTICUS PALLAS, IN MICHIGAN AND MONTANA. Dissert. Absts. 23 (9): 3059-3060; Biological Abstracts, Vol. 44, No. 1, Abst. No. 632. 1963.

6376. Ward, Fredrick James. 1962. REGULAR FLUCTUATIONS IN THE ANNUAL ABUNDANCE OF ADAMS RIVER RACE SOCKEYE SALMON AND THE OPERATION OF POSSIBLE CAUSAL AGENTS. Dissert. Absts. 23(6): 2265; Biological Abstracts, Vol. 44, No. 1, Abst. No. 633. 1963.

6377. Wolny, Pawel (Inst. Inland Water Fish., Olsztyn, Poland). 1962. THE USE OF PURIFIED

TOWN SEWAGE FOR FISH REARING. (PRZYDATONŚĆ OCZYSZCZONYCH ŚCIEKÓW MIEJSKICH DO HODOWLI RYB.) Rocz. Nauk Rolniczych Ser. B. Zootech. 81(2): 231-249; Biological Abstracts, Vol. 44, No. 1, Abst. No. 635. 1963.

Five ponds located near the town sewage disposal works of Kielce were filled and supplemented solely with purified sewage. They were biologically purified by the activated sludge process according to the Sheffield system. The purified sewage contained large amounts of mineral nitrogen salts in the form of nitrates (44.3 mg per l), phosphates (2.5 mg per liter) and other components. It was established from experiments in 1958-1961 that Kielce town sewage is suitable for direct feeding of all kinds of fish in winter ponds without previous diluting. The best results in carp fry rearing were attained in completely stagnant ponds. The increments of 2-year-old carp specimens in ponds with and without overflow (stagnant) did not differ; they kept within the range of 918 to 1184 kg per hectare. In ponds with overflow, a higher consumption of food fauna and increased mortality were observed. Thus, Hofer's finding, whereby a better effect of sewage purification is obtained with the use of overflow through fish ponds, has not been substantiated. The results of experiments and observations showed that in winter ponds supplied with biologically purified town sewage characterized by interior oxygen but superior trophic conditions, carp fry are less apt to lose weight than in ordinary winter ponds supplied with river water. (Auth.)

6378. Chernova, N. A. 1958. METHOD OF STUDY OF ALIMENTARY AND DEFENSE CONDITIONED REFLEXES IN FISH. (METODIKA IZUCHENIYA PISHCHEVYKH I OBORONITEL'NYKH USLOVNYKH REFLEKSOV U RYB.) Uch. Zap. Leningradsk. Gos. Univ. 239. 127-134; Referat. Zhur., Biol., 1959, No. 64288; Biological Abstracts, Vol. 44, No. 1, Abst. No. 920. 1963.

The given method, unlike previous methods, allows the recording of the general motor activity of the fish and the passage from one part of the aquarium to the other, together with its food-acquiring movements. (Courtesy NSF 83-480) 1963

6379. Arora, H. L., and R. W. Sperry (Calif. Inst. Technol., Pasadena, California). 1963. COLOR DISCRIMINATION AFTER OPTIC NERVE REGENERATION IN THE FISH ASTRONOTUS OCELLATUS. Develop. Biol. 7: 234-243; Biological Abstracts, Vol. 44, No. 1, Abst. No. 1901. 1963.

The ability of the completely divided optic nerve to regenerate and to restore accurate direction sense is well established in many fishes and amphibians. The present investigation was undertaken to find out if the perception of color also is restored in normal form by optic nerve regeneration. Fish were trained to jump at the correct (rewarded) one of two differently colored feeders and to avoid feeders of other colors and different shades of gray. It was found that the fish could discriminate the colors red, blue, yellow, and green both in the normal state and after complete section and regeneration of the optic nerve. When the color preferences were trained prior to optic nerve section, regeneration of the nerve resulted in reinstatement of the same color preferences, no relearning being necessary. Some of the implications regarding specificity of the optic fibers and factors governing their central synapsis in the optic tectum are discussed. (Authors)

6380. Molnar, G., and I. Tölg (Inst. Zool., Agric. Univ., Godollo, Hungary). 1962. EXPERIMENTS CONCERNING GASTRIC DIGESTION OF PIKE-PERCH (LUCIOPERCA LUCIOPERCA L.) IN RELATION TO WATER TEMPERATURE. Acta Biol. Acad. Sci. Hungaricae 13(3): 231-239; Biological Abstracts, Vol. 44, No. 1, Abst. No. 2475. 1963.

In order to clear up problems arising in food studies concerning natural populations in pikeperch (Lucioperca lucioperca L.) experiments were made in aquaria of different temperatures (5°, 10°, 15°, 20°, 25°C) in the course of which both time of the emptying of the stomach and rate of digestion were observed. Bleak (Alburnus alburnus L.) of 8-10 cm length were artificially fed to the test animals which had a length of 25-30 cm. A special X-ray method was designed to register the emptying of the stomach and rate of digestion. Except for changes in temperature, the experiments were performed under equal conditions. Ten test animals were used for each experimental temperature. The average rates of gastric digestion at temperatures of 5°, 10°, 15°, 20°, and 25° C were 257, 157, 83, 45, and 28 hours, respectively. Putting the observed data into a system of coordinates, the curve of digestion can be expressed as $y = 473.15 \times 1.12^{-x}$. A straight line was obtained by plotting the logarithms of the length of digestion on the ordinate. From this straight line the rate of digestion may be read with approximate accuracy also at temperatures at which no experiments were performed. According to the radiographs, pikeperch do not rotate the ingested fish in the stomach during digestion. The effect of temperature on the rate of digestion in pikeperch is so decisive that this factor should be considered both in food studies and in discussions regarding the role of organic matter in the diet of predaceous fishes. (Authors)

6381. Nandi, Jean. 1962. THE STRUCTURE OF THE INTERRENAL GLAND IN TELEOST FISHES. Univ. Calif. Publ. Zool. 65(2): 129-212; Biological Abstracts, Vol. 44, No. 1, Abst. No. 2782. 1963.

Teleosts of 130 species, comprising 61 families, were studied for structure of the interrenal gland. No correlation was detected between the interrenal morphology and the physiology, the ecology, or the taxonomic position of any of the species studied. No major evolutionary trends were apparent among the teleosts as a whole. Variations in the morphology of interrenal and chromaffin tissues appear to be related to the acquisition of an adequate vascular supply. In this investigation, interrenal tissue has

been classified according to its distribution and its relation to blood vessels within, or interior to, the kidney. Interrenal tissue may be found around the postcardinal veins and their major branches (Type I), around small ramifications of the postcardinal veins (Type II), dispersed as clumps or strands of cells associated with venous sinuses (Type III), or as a localized mass of cells not necessarily associated with major blood vessels (Type IV). A variety of intermediate types was also encountered. Unlike the interrenal tissue, the chromaffin tissue of teleosts is invariable in its location within the walls of the postcardinal veins and/or their branches. It is postulated that the primitive location of both interrenal and chromaffin cells is in the walls of the postcardinal veins and their major branches. A primitive association is, therefore, suggested. (S. M. B. P.)

6382. Mackenthun, K. M. (Robt. A. Taft Sanit. Engng. Ctr., Cincinnati, Ohio). 1962. A REVIEW OF ALGAE, LAKE WEEDS, AND NUTRIENTS. Jour. Water Poll. Control Fed. 34(10): 1077-1085; Biological Abstracts, Vol. 44, No. 1, Abst. No. 3753. 1963.

Magnitude of standing weed crops is reviewed along with growth factors, N and P cycles, and external nutrient sources. Temporary chemical control of weeds and algae is discussed with emphasis on use of Cu and sodium arsenite. (I. G.)

6383. Michel, Curtis (Molecular Technology, Inc., 90 Broad Street, New York, N. Y.). 1963. EVAPORATION CONTROL: A NEW TOOL FOR WATER MANAGEMENT. Journal of Soil and Water Cons., Vol. 18, No. 6, pp. 223-229.

Various evaporation suppression techniques, such as, roofing reservoirs, siting and phreatophyte removal have been proposed; however, the use of monomolecular films appears to give the most promising results. The film-forming agents most effective under conditions existing on open reservoirs are normal hexadecanol and normal octadecanol, and so-called higher fatty alcohols. These wax-like compounds are safe for use on public water supplies and are harmless to man, animals, birds, fish and most insects. Several methods of application, field problems and costs are discussed. Despite some problems attendant to its application, the most effective form of straight-chain compound for evaporation control is a dry material, preferably a specially compounded blend of normal hexadecanol and normal octadecanol, free of contaminants, and in as small a particle size as feasible to allow application to water surfaces. Two methods of application of evaporation suppressants have been used successfully: dusting with a grinder-duster which abrades a solid form of the film-forming compound, and dusting of finely pulverized powder through adapted blowers from a boat or plane.

6384. Goodell, B. C. (Rocky Mountain Forest and Range Experiment Sta., Fort Collins, Colorado). 1963. A REAPPRAISAL OF PRECIPITATION INTERCEPTION BY PLANTS AND ATTENDANT WATER LOSS. Journal of Soil and Water Cons., Vol. 18, No. 6, pp. 231-234.

Recently published, laboratory-type studies have suggested that the vaporization of rain or snow intercepted by vegetation may result in a water loss from that site that is less real than apparent because of a compensating reduction in transpiration.

The magnitude of such compensation under field conditions is questioned in view of (a) transpiratory regulation by plants under the stress of limited water availability, (b) probability that the energy available for evapotranspiration from wet leaves is greater than from dry leaves, and (c) the possibility that under winter conditions in cold climates transpiration is limited more by the availability of water than of energy and that interception increases the quantity of water favorably exposed to the energy supply.

Further and more analytical studies are needed to reveal the true importance of interception as a factor that affects water yield from a site or its availability for plant growth. (Auth.)

6385. Otto, L. 1962. CURRENT BIBLIOGRAPHY FOR AQUATIC SCIENCES AND FISHERIES. FAO Fish. Biol. Tech. Paper 25. 1-32; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4439. 1963.

6386. Frey, David G. (Edited by.) 1963. LIMNOLOGY IN NORTH AMERICA. Univ. of Wisconsin Press (Madison 6, Wisconsin), 734 pp.; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4880. 1963.

The papers in this volume study the processes going on in the aquatic environment and the responses of organisms to, and their participation in, these processes. Prominent limnologists have contributed information on various aspects of limnology for each of several subdivisions of the North American continent. Coverage of these regions includes material on limnological resources, a history of limnological endeavor, the major fields and accomplishments, problems and potential, and a representative listing of published papers. Additional chapters are devoted to reservoirs, farm ponds, paleolimnology, sanitational limnology, and the history of the American Society of Limnology and Oceanography. References to, or abstracts of, these papers will be in pertinent sections of "Biological Abstracts." There is an index.

6387. Burmakin, E. V. 1960. RESULTS OF WORK ON DEPOPULATING (THE FISH OF) TWO LAKES IN THE LENINGRAD OBLAST. (REZUL'TATY RABOT PO OBEZRYBLIVANIYU DVUKH OZER LENINGRADSKOI OBLASTI.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozernogo Rechnogo. Rybn. Khoz. 12. 20-24; Referat. Zhur., Biol., 1963, No. 3I81; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4902. 1963.

The results are presented of experiments on the extermination of fish by polychlorpinene at a concentration of up to 0.50 ml/l.

6388. Dryagin, P. A. 1961. BASIC PROBLEMS IN

THE DEVELOPMENT OF THE LAKE FISHING INDUSTRY IN THE USSR. (OSNOVNYE ZADACHI RAZVITIYA OZERNOGO RYBNOGO KHOZYAISTVA V SSR.) Nauchn.-Tekh. Byul. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 13/14. 21-24; Referat. Zhur., Biol., 1963, No. 3I80; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4907. 1963.

Figures of the annual gross catch of fish in USSR lakes and their species composition are presented. The considerable successes of fishery research on lakes are noted, as well as the positive results obtained in increasing their fish productivity by stocking with valuable fish, extermination of waste fish using polychlorpinene, the control of mortality due to lack of oxygen (winter kill) by Reshetnukov's aerator, and so forth. The fundamental tasks of further development of the lake fishing industry are enumerated.

6389. Fromm, P. O., and R. M. Stokes (Michigan State Univ., East Lansing). 1962. ASSIMILATION AND METABOLISM OF CHROMIUM BY TROUT. Jour. Water Pollution Control Fed. 34(11): 1151-1155; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4910. 1963.

Uptake of hexavalent chromium by trout was studied over the exposure range of 1.3 ppb to 2.5 ppm. At dosages of up to 0.01 ppm, maximum tissue content was obtained within 12 days exposure. At dosages beyond 0.05 ppm, fish continued to accumulate chromium beyond the maximum 30-day exposure period. Oxygen consumption by liver, kidney, and pyloric caeca tissue from fish exposed to 1 ppm equaled that for tissue from control fish. (I. G.)

6390. Grygierek, Eugenia (Inst. Inland Water Fish., Olsztyn, Poland). 1962. THE EFFECT OF INCREASING THE CARP FRY DENSITY ON CRUSTACEAN PLANKTON. (WPLYW ZAGESZCZENIA NARYBKU KARPI NA FAUNE SKORUPIAKÓW PLANKTONOWYCH.) Rocz. Nauk Rolniczych Ser. B. Zootech. 81(2): 189-210; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4913. 1963.

Experiments were conducted in 8 ponds in 1958, and in 16 in 1959, at Zabieniec. The ponds were stocked with 1 g carp fry. The abundance of stocked population ranged from 0 to 22,500 specimens per hectare. The ponds were of identical size (0.2 ha) and depth (1 m). They were supplied with water from a river by means of pumps. The filling of the ponds took place about the middle of June. The supply of water was stopped in the middle of October, and then the ponds were gradually drained. In 5 of the ponds the fish were fed barley beginning in the middle of the season. There was more plankton in the stocked ponds than in the non-stocked ponds. Crustacea appeared in greater numbers in the stocked ponds as the result of increased reproduction. Their productivity did not increase in the second half of the season. However, the number of Crustacea in ponds stocked with more than 7500 specimens per hectare decreased but it never dropped below the figure observed in non-stocked ponds. The drop in crustacean population was particularly marked in ponds where the fishes were not supplied with food by man. Although the number of Crustacea increased in stocked ponds, their biomass decreased. The stocking of a pond with 2500 specimens per hectare, and most likely with a smaller number, brings about a several-fold reduction of the biomass of Crustacea. Any further increase of stocked fish population does not produce any marked changes in the trends of the biomass. In ponds with 2500 specimens per hectare and above, no Daphnia magna, the most important species in plankton biomass, appeared at all or it appeared only early in the season. (Auth.)

6391. Gulland, J. A. (Fish. Lab., Lowestoft, England). 1962. THE APPLICATION OF MATHEMATICAL MODELS TO FISH POPULATIONS. In: E. D. Le Cren and M. W. Holdgate, Editors. The Exploitation of Natural Animal Populations. A Symposium, 1960. John Wiley and Sons, Inc. (New York 16, N. Y.), pp. 204-220; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4915. 1963.

6392. Lindstrom, Thorolf, and Nils-Arvid Nilsson (Sötvattenslab., Drottningholm, Sweden). 1962. ON THE COMPETITION BETWEEN WHITEFISH SPECIES. The Exploitation of Natural Animal Populations. A Symposium, 1960. John Wiley and Sons, Inc. (New York 16, N. Y.), pp. 326-340; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4933. 1963.

The first-year biology of three Coregonus species has been studied. C. pidschian and C. lavaretus have the same hatching places in some cases. The habitat segregation between C. peled and C. lavaretus is broken down during late summer and autumn; their feeding habits are similar and their growth curves do not diverge until after the first year. These similarities are such that it is difficult to envisage how the necessary isolation is established during this year of high mortality. In the adults there is an obvious segregation into different feeding niches. It is suggested that this segregation is made possible by a behavior mechanism, resulting in a changeable food specialization and that the segregation is primarily the result of species interaction. The interaction also has effects on the growth of the fish, some species being forced to eat food that causes slow growth (plankton). (Authors)

6393. Ludemann, D., and H. Neumann (Inst. Wasser, Boden-u. Lufthyg., Biol., Berlin Dahlem, W. Germany). 1962. THE EFFECT OF MODERN CONTACT INSECTICIDES ON FRESH-WATER FAUNA. (ÜBER DIE WIRKUNG DER NEUZEITLICHEN KONTAKTINSEKTIZIDE AUF DIE TIERE DES SÜSSWASSERS.) Anz. Schadlingskunde 35(1): 5-9; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4935. 1963.

Toxicity of chlorinated hydrocarbons and organo-phosphorus insecticides was determined for a number of fresh-water fauna. Both minimum

and absolute lethal doses were calculated on 24-, 48-, and 96-hour bases. Minimum toxic concentrations were highly variable between species, but generally chlorine compounds were toxic at a range of 0.1-1.0 mg/l, while the phosphorus compounds were toxic at higher concentrations. Endrin, thiodan, toxaphene, DDT, and dieldrin proved especially toxic to rainbow trout, carp, and tadpoles. All of the tested insecticides proved either lethal or noxious to at least some organisms at concentrations as low as 0.1 mg/l. A necessity for strenuous efforts to avoid contaminating water with insecticides is stressed. (J. G.)

6394. Madden, K. M., and A. D. Lynch (State Cons. Comm., Des Moines, Iowa). 1962. NOTES ON THE FIRST REARING AND INTRODUCTION OF ESOX MASQUINONGY IN IOWA WATERS. Proc. Iowa Acad. Sci. 69: 273-277; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4937. 1963.

The Iowa State Conservation Commission purchased 1,535 muskellunge (3/4- to 1-inch fry) in 1960, from "Kenu," a Land-O-Lakes, Wisconsin, commercial fish hatchery. Siewers Spring State Fish Hatchery and rearing pond facilities were used for the experimental rearing project. Eighty-five fish survived the June 7 to September 30 rearing period. Forty fish were stocked in each of the following Iowa lakes: West Okoboji, Dickinson County, and Clear Lake, Cerro Gordo County. Two specimens have subsequently been recovered and identified from each lake. (Authors)

6395. Roedel, Phil M. (California Dept. Fish and Game, Terminal Island). 1963. THE NAMES OF TUNAS AND MACKERELS. California Fish and Game 49(2): 119; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4945. 1963.

Based on evidence presented at the FAO World Tuna Meeting (1962), California will henceforth regard the albacore, bigeye, bluefin and yellowfin tunas as world-wide species, all referable to genus Thunnus. The skipjack tuna remains in genus Katsuwonus; the Pacific mackerel is returned to genus Scomber. (Auth.)

6396. Schiemenz, F. 1961. AVOIDANCE OF DAMAGE TO FISH WHEN EMPLOYING SPRAYS AGAINST AGRICULTURAL PESTS. (DIE VERMEIDUNG VON SCHÄDIGUNGEN DER FISCHEREI BEI DER ANWENDUNG VON SPRITZMITTELN GEGEN LANDWIRTSCHAFTLICHE SCHADLINGE.) Anz. Schadlingskunde 34(5): 65-71; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4947. 1963.

Practically all sprays used against rodents, insects, fungi, and weeds can be poisonous to fish. Moreover, killing of the flora and fauna on which fish feed can also damage fishlife. Spraying of fruit trees bordering drainage ditches containing nearly stagnant water has killed the fish, but when these ditches contain running water, it is possible to avoid this consequence. Extermination of moles in such drainage areas is best accomplished by localized spraying, not by aerial sprays. If the larger ditches are stocked with pike, and a flow of water maintained, the mole population can be reduced. Extermination of the liver-fluke transmitting snail by sprays is limited to damp meadows, stagnant water, and small drainage ditches; when the ditches contain running water, other measures must be taken, and these can best be selected by a specialist (veterinarian). Surface spraying can be carried out so that the poisons do not enter the water. Suitable precautions must be taken so that there is no backflow of spray into the local water when the latter is pumped in to serve as diluent. Contaminated water containing poisonous residues must not be emptied into the ditches. Most damage occurs through carelessness or negligence; therefore, suitable precautions are essential and punitive laws should be passed and enforced. (Auth.)

6397. Tarzwell, C. M. (Robt. A. Taft Sanit. Engng. Ctr., Cincinnati, Ohio). 1962. DEVELOPMENT OF WATER QUALITY CRITERIA FOR AQUATIC LIFE. Jour. Water Pollution Control Fed. 34(11): 1178-1185; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4953. 1963.

Essential features are presented for a continuing research program designed to develop water quality criteria for aquatic life of both commercial and recreational value. These include classification of wastes and their possible adverse effects, such as, oxygen depletion, direct toxicity, inert suspended materials, temperature elevation, production of off-flavors, radiation contamination, and sublethal physiological effects produced by toxic agents. Scope of studies needed to establish quality criteria in each of these areas is discussed, and value of such criteria is underscored. (I. G.)

6398. Templeton, W. L., and V. M. Brown (Radiobiol. Group, United Kingdom Atomic Energy Authority, Windscale Works, Cumberland, England). 1963. ACCUMULATION OF CALCIUM AND STRONTIUM BY BROWN TROUT FROM WATERS IN THE UNITED KINGDOM. Nature 198(4876): 198-200; Biological Abstracts, Vol. 44, No. 2, Abst. No. 4954. 1963.

6399. Kisch, Bruno, and Delbert E. Philpott (City Hosp. Elmhurst, Elmburst, N. Y.). 1963. ELECTRON MICROSCOPY OF THE HEART OF FISH. I. THE GOLDFISH HEART. Exptl. Med. and Surg. 21(1): 28-53; Biological Abstracts, Vol. 44, No. 2, Abst. No. 5543. 1963.

6400. Kisch, Bruno, and Delbert E. Philpott (City Hosp. Elmburst, Elmhurst, N. Y.). 1963. ELECTRON MICROSCOPY OF THE HEART OF FISH. II. THE HEART OF SELACHIANS (DOGFISH AND TORPEDO). Exptl. Med. and Surg. 21(1): 54-74; Biological Abstracts, Vol. 44, No. 2, Abst. No. 5544. 1963.

6401. Wagner, Henry G. (Naval Med. Res. Inst., Bethesda, Maryland), Edward F. MacNichol, Jr.,

and Myron L. Wolbarsht. 1963. FUNCTIONAL BASIS FOR "ON"-CENTER AND "OFF"-CENTER RECEPTIVE FIELDS IN THE RETINA. Jour. Optical Soc. Amer. 53(1): 66-70; Biological Abstracts, Vol. 44, No. 2, Abst. No. 6232. 1963.

The ganglion cells in the goldfish retina may have either "on"-center or "off"-center receptive fields. Evidence is presented to show that for any cell: (1) Under suitable conditions either pure "on" or pure "off" responses can be evoked by small spot stimuli at any point within the receptive field. (2) The sensitivities of both "on" and "off" processes are maximal in the center of the field. (3) The relative sensitivity of these processes is not constant but changes as a function of position in the field. (4) The response evoked by a stimulus of any size and at any location within the receptive field represents the sum of the contributions from both the "on" and "off" processes. (Authors)

6402. Crandall, Catherine A., and Clarence J. Goodnight (Dept. Biol. Sci., Purdue Univ., West Lafayette, Indiana). 1963. THE EFFECTS OF SUBLETHAL CONCENTRATIONS OF SEVERAL TOXICANTS TO THE COMMON GUPPY, LEBISTES RETICULATUS. Trans. American Microscop. Soc. 82(1): 59-73; Biological Abstracts, Vol. 44, No. 2, Abst. No. 6573. 1963.

The effect of prolonged exposure to sublethal concentrations of Pb, Zn, and sodium pentachlorophenate were studied in the common guppy, L. reticulatus. The concentrations used in this experiment were 2 ppm Pb $(NO_2)_2$ (1.24 ppm as Pb), 5 ppm hydrated Zn SO_4 (1.15 ppm as Zn) and 0.5 ppm sodium pentachlorophenate. In addition to these concentrations, several fish were placed in 5 ppm Pb $(NO_3)_2$ (2.48 ppm as Pb) and 10 ppm hydrated Zn SO_4 (2.30 ppm as Zn). It was found that in all the experimental animals histo-pathologic changes were observed in the experimental fish when compared with the histology of the control fish. Several histologic changes were observed in all fish exposed to the 3 toxicants. These included lack of mesenteric fat, reduction of renal peritubular lymphoid tissue, and an apparent dilation of renal tubules with degeneration of tubular epithelial cells. Gonadal development was retarded in all experimental groups and occasionally degenerative changes were evident. In the heavy metal solutions histological changes suggesting cardiac damage and blood cell destruction were found. Liver damage was evident in fish exposed for long periods to sodium pentachlorophenate. In 10 ppm Zn extensive degeneration was observed in many organs. The histopathology, growth inhibition and retardation of sexual maturity suggest that the secondary effects of inanition and/or stress were the most prominent features of the chronic intoxications produced in this study.

6403. Ghittino, P., and F. Ceretto (Ist. Gen. Pathol. and Pathol. Anat., Fac. Vet., Univ. Turin, Turin, Italy). 1962. STUDY ON THE ETIOPATHOGENESIS OF HEPATOMA IN HATCHERY RAINBOW TROUT. (STUDIO SULLA EZIOPATOGENESI DELL'EPATOMA DELLA TROTA IRIDEA DI ALLEVAMENTO.) Tumori 48(6): 393-410; Biological Abstracts, Vol. 44, No. 2, Abst. No. 6729. 1963.

Rainbow trout reared in hatcheries often develop liver tumors. The development of such tumors is always preceeded by the onset of a degenerative process, consisting in the accumulation within both parenchymal cells and histiocytes of ceroid. This peculiar type of degeneration is called "liver lipid degeneration." The histological development of tumors is studied. The authors emphasize the idea that the tumors are a consequence of regenerative-hyperplastic phenomena following degeneration. They think the liver degeneration is provoked by feeding fishes on unbalanced dry diets. (M. V. D.)

6404. Guse, Lynn Robert. 1963. PHYSIOLOGICAL AND RESIDUAL STUDIES OF HERBICIDES FOR AQUATIC WEED CONTROL. Dissert. Absts. 23(10): 3605; Biological Abstracts, Vol. 44, No. 2, Abst. No. 8049. 1963.

6405. New, John G. (Sci. Dept., State Univ. Coll., Oneonta, New York). 1963. SPAWNING BEHAVIOR OF THE SHIELD DARTER, PERCINA PELTATA (PISCES, PERCIDAE). Proc. of the XVI International Congress of Zoology, Vol. 2, p. 17.

The shield darter inhabits large streams and rivers in the eastern United States where it is confined ecologically to areas with a gravel substrate.

Spawning occurs in late April and early May. Males establish territories but these are not rigid. Females enter the territory when ripe and ready to spawn but may move out of the territory during the time when males are fighting or when pursued by males.

Male aggressive display often prevents a fight, but fighting does take place and is vigorous especially within the territorial boundaries. Males sometimes defend the territory against females regardless of their readiness to spawn.

Females solicit spawning by representing themselves in the territory of the male or directly in front of a male when territorial behavior breaks down in the aquarium. Males mount females from the side and first bring the area of the isthmus into contact with the dorsal region of the female. A series of enlarged caducus scales is present in the male along the mid-line of the belly. Each scale has several long spines projecting from it. These scales apparently serve as contact organs. Rubbing these scales on the female, especially in the region of the nape, is stimulatory and if the female is ready to spawn she will permit the male to mount. Spawning takes place when the male has brought his body parallel to, above and in contact with that of the female. The male's dorsal fins are erect, the female's are depressed. His anal fin is to one side of her body and, as both male and female vibrate, the milt flows down the

side of the fin closest to her body. The female's ventral region is at the surface of the gravel but is sometimes below. As spawning occurs both fish move forward through the gravel, thus distributing the eggs in a line. Spawning lasts about ten seconds.

When ripe, females will spawn over and over again. One female was noted spawning twelve times within a three-hour period.

6406. Ali, M. A. (Dept. Biol., Univ. Montreal, Montreal, Quebec, Canada). 1963. SOME ASPECTS OF THE RETINAL PHYSIOLOGY OF SALMON (SALMO SALAR). Proc. of the XVI International Congress of Zoology, Vol. 2, p. 70.

The structure of the Atlantic salmon retina corresponds to descriptions by previous workers and is also similar to that of the Pacific salmon retina. It is capable of pronounced photomechanical changes in response to variations in light conditions. Retinal epithelial pigment (REP) light-adapts in 60 min. Cones light-adapt in 45 min. Dark-adaptation of REP and cones occurs in 70 min. (Can. J. Zool. 39: 123. 1961). Retinae of fish exposed to 900 ft-c are more fully adapted to light than those of fish exposed to 0.1 ft-c. Retinae of the former group take a shorter time to attain the same state of adaptation as that of the latter. However, they take a longer time than the latter to attain their own maximum state of adaptation. Retinae of fish subjected to darkness after exposure to 900 ft-c are not dark-adapted even after 70 min. REP of fishes placed in darkness from light of 0.1 ft-c dark-adapts in 45 min. while the cones do so in 25 min. REP dark-adapts in light intensities below 0.001 ft-c. Cones are in a light-adapted state in intensities of 0.01 ft-c and above, semi-adapted state in 0.001 ft-c, and dark-adapted state in 0.0001 ft-c and below. It is suggested that the visible spectrum of the yearling Atlantic salmon ranges from 3640 A to 6900 A because the retina is in a light-adapted state in that range. In light, lower and higher temperatures bring about an expansion of REP. Cones are not affected. In dark, REP expands with higher temperatures but temperatures exceeding 18.3° C bring forth contraction. Cones contract with increasing temperatures but beyond 14.8° C they expand. Cones exhibit no rhythm in their positions in continuous light or dark. REP demonstrates no rhythm in light but shows one in dark which persists for a day. Enucleated eyes from light- and dark-adapted fish were subjected to light and darkness for one hour and fixed in Bouin's. In all cases one eye of each fish was placed in light and the other in darkness. REP remains in approximately the same state it was in at the time of enucleation regardless of whether it was placed in light or darkness. Regardless of whether they were placed in light or in darkness, cone myoids of dark-adapted fish remain expanded while those from light-adapted eyes become expanded or relaxed. It is suggested that the retina of salmon dies within an hour after enucleation. This renders it difficult to ascertain whether the cones in the enucleated eyes are capable of responding to light and darkness, or not. However, it appears certain that the REP is incapable of responding to changes in light conditions when the blood and/or nerve supply are interrupted.

6407. La Roche, Gilles, C. L. Johnson, A. N. Woodall, and L. L. Rosenberg (Western Fish Nutrition Lab., U. S. Fish and Wildl. Serv., Willard, Washington). 1963. IODINE METABOLISM IN ADULT KING SALMON (ONCORHYNCHUS TSHAWYTSCHA, WALBAUM). Proc. of the XVI International Congress of Zoology, Vol. 2, p. 154.

In early May 1962, 66 migrating male and female adults were intercepted at Bonneville Dam and held in covered cement raceways at the Willard Fish Hatchery. The animals were kept in running fresh-water containing 0.25 μg I^{127}/liter at a temperature of 6 ± 1° C. On three separate occasions (late May, early August and middle of September) groups of fish received carrier-free I^{131} or I^{125} intraperitoneally. Following injection, fish were sacrificed at intervals by a blow on the head, and in rapid succession were bled, their thyroid regions and pieces of caudal muscle were removed. Whole blood, plasma and serum samples were prepared for scintillation counting and I^{127} determinations. Meanwhile, in the isolated thyroid regions, the ventral aorta and proximal part of the branchial arteries were rapidly exposed, dissected out with surrounding tissues, homogenized and digested for 24 hrs at 37° C in pancreatin. Aliquots of this hydrolysate were used for counting, microiodine determinations and chromatographic separation of thyroid metabolites. Similarly, pieces of caudal muscle were hydrolyzed prior to counting and I^{127} determinations. Between late May and middle September, as fish attain sexual maturity, the iodine contents of blood and thyroids fall to as much as a third of their original values in both males and females. During this period the total serum iodine (I^{127}) decreased from 34.0 to 11.0 μgm I per 100 ml. The organically-bound fraction of the serum decreased from 23.7 to 6.7 μgm I/100 ml. A peak of total serum radioiodine appeared at 24 hrs after injection with an average of 0.1% of the injected dose per ml in all three groups of adults. The thyroid gland I^{127} content decreased from 49.4 to 17.1 μgm I per thyroid gland. On the other hand, muscle I^{127} remained constant throughout at 0.5 μgm per gm of tissue. The I^{131} or I^{125} thyroidal uptakes indicate maxima of 0.9 to 3.6% (average at 2.0%) of the injected dose at 336 hrs (2 weeks) following injection. In May and early August the rates of uptake appeared identical and it is only in mid-September that a slowing of this rate can be noted. Paper chromatography shows a slow incorporation of labelling in intrathyroidal iodo-amino acids as compared to mammals and chicken. In early August 10% of the glandular I^{125} is in the thyroxine fraction at 72 hrs following injection. By mid-September identical distribution of labelling can be noted even though the rate of thyroidal

uptake appears to have dropped. There are no significant sex differences in thyroidal parameters examined.

6408. Foster, Neal R. (Dept. of Cons., Cornell Univ., Ithaca, New York). 1963. REPRODUCTIVE BEHAVIOR PATTERNS AND FUNCTIONAL ANATOMY OF SOME AMERICAN OVIPAROUS CYPRINODONT FISHES. Proc. of the XVI International Congress of Zoology, Vol. 1, p. 158.

Phylogenetic relationships among the oviparous cyprinodonts, or killifishes (Cyprinodontidae), are obscured by convergence, divergence, geographic variation, and the lack of an adequate fossil record. Comparative ethological studies were begun in the hope of finding new information of systematic significance.

The attributes of oviparous cyprinodonts for comparative studies on reproductive behavior are their general availability, relative ease of maintenance, small size, early maturity, and frequent spawning. The species studied include Cyprinodon variegatus, Jordanella floridae, Adinia xenica, Fundulus majalis, F. similis, F. heteroclitus, F. diaphanus, F. chrysotus, F. cingulatus, Lucania parva, Lucania goodei, Leptolucania ommata and some South American, African, and Asiatic species. Field and aquarium observations and morphological studies have led to the following generalizations: The sexually mature male in almost every species of killifish has contact organs distributed on certain parts of the body and/or fins. These tiny spine-like structures are restricted to those parts which consistently come in contact with the female during courtship or spawning, and they appear to function primarily as tactile organs. Similar distributions of contact organs are seen in species reported to hybridize in nature (Fundulus heteroclitus x F. diaphanus and Lucania parva x L. goodei.).

Branched epiotic processes and/or bifid supraoccipital processes on the rear of the skull occur in those North American species in which the male vocalizes during courtship while flicking his head laterally. Sound production and contacting appear to have been selected for in those forms which spawn in waters where visibility is poor. On the other hand, extreme sexual dimorphism and dichromatism characterize species which spawn where visual displays can play a predominant role in the reproductive behavior.

Study supported by NSF G-23395.

6409. Svetovidov, A. N. (Zool. Inst., Acad. of Sciences, Leningrad, U.S.S.R.). 1963. THE SYSTEMATICS, ORIGIN AND HISTORY OF DISTRIBUTION OF THE EURASIATIC AND NORTH AMERICAN SPECIES OF PERCA, LUCIOPERCA AND STIZOSTEDION. Proc. of the XVI International Congress of Zoology, Vol. 1, p. 212.

A few families of fresh-water fishes common to Eurasia and North America are represented in both continents by identical species, subspecies of the same species or by congeneric species. Of special interest in many respects is the Percidae. It is not clear if Perca is represented in Eurasia and North America by species or by subspecies of the same species as well as if the European species of pikeperches are referred to Lucioperca and American ones to Stizostedion or should be united under one name.

The study of general and osteological characters enables a statement that the European and North American perches should be recognized as subspecies, P. fluv. fluviatilis and P. fluv. flavescens. The perch of the Kolyma River, being intermediate between them in the main characters, is described as P. fluv. intermedius sbsp. n. There are no such differences in general and craniological characters between Lucioperca and Stizostedion as those from other genera of the family, from Perca in particular. L. marina is intermediate between both genera. Therefore, there is no reason to divide both genera and they are united under one name, Lucioperca.

The considerations on the origin and history of distribution of the genera studied are given. Fossil remains of both genera have been reported from Western Siberia and adjacent regions, those of Perca beginning from the middle and lower Miocene and of Lucioperca from the Oligocene. In Europe the fossil remains of Perca have been found in the Pliocene and those of Lucioperca in the bordering strata of the Tertiary and Quarternary formations. From North America the fossil remains of Percidae are reported only in the Pleistocene. All these facts and the recent distribution indicate the Palaearctic origin of the subfamily Percinae, including both genera studied, and the migration of P. fluviatilis to North America through Behringian land. Because of systematic relationship between the North American species of Lucioperca and L. marina, which inhabits the Caspian Sea and brackish parts of the Black Sea, the migration of the genus to North America along the land connection across the Atlantic is suggested.

6410. McNeil, William J. (U. S. Bur. of Comm. Fish., Biol. Lab., Auke Bay, Alaska). 1963. QUALITY OF THE SPAWNING BED AS IT RELATES TO SURVIVAL AND GROWTH OF PINK SALMON EMBRYOS AND ALEVINS AND TIME OF FRY EMERGENCE. Proc. of the XVI International Congress of Zoology, Vol. 1, p. 242.

Growth, development, and survival of embryos and alevins of salmonid fishes are affected by the availability of dissolved oxygen in spawning beds. The oxygen supply rate to an embryo or alevin is a function of dissolved oxygen content and apparent velocity of intragravel water.

Oxidizing organic detritus, interchange between stream and intragravel water, and permeability of bottom materials exert a significant influence on the amount of oxygen made available to embryos and alevins. Growth and survival of pink salmon (Oncorhynchus gorbuscha) embryos and alevins in a small southeastern Alaska stream were found to be related to these environmental attributes. Evidence was

also obtained that fry emergence was delayed where environmental factors were most likely to cause occurrence of oxygen stress during development.

6411. Darnell, Rezneat M. (Dept. Biol., Marquette Univ., Milwaukee, Wisconsin). 1963. NITROGEN TURNOVER IN AN ESTUARINE FISH POPULATION. Proc. of the XVI International Congress of Zoology, Vol. 1, p. 243.

This study of the nitrogen turnover in a population of pinfish (Lagodon rhomboides) in the North Carolina estuary is based upon the following procedure:

(1) Determination of nitrogen content of fish in relation to body length;

(2) Laboratory study of growth at different rates of nitrogen intake;

(3) Study of growth rates in the natural population;

(4) Estimation of the natural daily food intake (average daily meal) at intervals during the growth period; and

(5) Analysis of the nitrogen content of the several average daily meals.

The critical and difficult part of this study has been the estimation of daily meals in the natural population. This has been accomplished as follows:

(1) Laboratory analysis of factors influencing the rate of food movement through the stomach;

(2) Quantitative stomach analysis of fish collected at 2-hour intervals throughout the 24-hour periods and preserved immediately upon collection; and

(3) Quantitative stomach analysis of fish collected at 2-hour intervals throughout the 24-hour periods but kept in live cages in the estuary (isolated from food) for 2 hours prior to preservation.

Results of the study are discussed in relation to the nitrogen cycle of the estuary.

6412. Miller, Robert Rush (Museum of Zool., The Univ. of Michigan, Ann Arbor). 1963. EXTINCT, RARE, AND ENDANGERED AMERICAN FRESH-WATER FISHES. Proc. of the XVI International Congress of Zoology, Vol. 1, p. 244.

Approximately 10 species of fresh-water fishes have become extinct in the United States and northern Mexico since the close of the nineteenth century. About 30 additional species are now either rare, of very restricted range, or are threatened with extermination. Reasons for the elimination and decline of fresh-water fishes are given and suggestions are made for the preservation of endangered forms.

6413. Smoker, William A. (Auke Bay Biol. Lab., Auke Bay, Alaska). 1963. INFLUENCE OF FRESH-WATER ENVIRONMENT ON SURVIVAL OF COHO SALMON. Proc. of the XVI International Congress of Zoology, Vol. 1, p. 245.

Adult coho salmon, Oncorhynchus kisutch, are caught in their final year of life in certain fisheries in the Northeast Pacific Ocean along the North American continent. The abundance of salmon in the annual catches is found to fluctuate at times in a similar manner as the amount of water discharged during the juvenile residence of the salmon in their natal fresh-water streams. The procedure for measuring salmon abundance and combined stream discharges is described, and the possible reasons for the close correlations are discussed.

6414. Johnson, D. S., and Maureen H. H. Soong (Dept. Zool., Univ. of Singapore, Singapore). 1963. THE FATE OF INTRODUCED FRESH-WATER FISH IN MALAYA. Proc. of the XVI International Congress of Zoology, Vol. 1, p. 246.

Fish have often been successfully introduced to temperate fresh-waters. It is of interest to know what happens to fish introduced into areas with richer faunas. Malaya has about 250 species of fresh-water fish. Numerous other species have been introduced. Only 5 are generally established, and no species has successfully invaded natural forest habitats. Lebistes reticulatus, Gambusia affinis, and Mollienessia sp. are all of New World origin and, significantly, all belong to the viviparous Poeciliidae. Only Lebistes really flourishes. Individuals of Mollienessia and hybrids between this and Lebistes are found in Singapore; but these could represent repeated introductions. Reports in the literature claim that Gambusia was successfully established in Malaya as a mosquito control measure. These are without factual basis, but a small population is surviving in a polluted stream, the S. Whampoa, in Singapore. Lebistes occurs in large numbers in much disturbed or highly polluted habitats in and near towns, including ponds, canals, drainage ditches, and monsoon drains. Its success is partly due to its needing no special breeding site and to its high fecundity. It is also due to its ability to withstand conditions which few or no other fish can tolerate. Lebistes has not been found in less disturbed and polluted habitats, such as riceland ditches. These usually have a richer native fish fauna. These data indicate that introduced forms only flourish where they can exploit an unusual habitat not available to the general local fauna. Conditions in these polluted waters approximate those of natural swamps in semi-tropical areas. With the possible exception of Puntius semifasciolatus, all of these successful, introduced species originate from such habitats.

6415. Carson, Rachel. 1962. POISONED WATERS KILL OUR FISH AND WILDLIFE. Audubon 64(5): 250-253; Biological Abstracts, Vol. 44, No. 3, Abst. No. 8708. 1963.

6416. Anonymous. 1963. WILDLIFE RESEARCH PROGRESS (IN THE UNITED STATES) 1961. U. S. Fish and Wildl. Serv. Circ. 146. 1-50; Biological Abstracts, Vol. 44, No. 3, Abst. No. 8757. 1963.

6417. Parker, Richard A. (Computing Center, Washington State Univ., Pullman). 1963. ON THE ESTIMATION OF POPULATION SIZE, MORTALITY, AND RECRUITMENT. Biometrics 19(2): 318-323; Biological Abstracts, Vol. 44, No. 3, Abst. No. 8929. 1963.

A mark and recapture method for estimating population size, instantaneous rate of mortality, and absolute rate of recruitment is proposed. Marking is done once and successive subsequent samples are without replacement. Recruitment is assumed to be linear and independent of initial population size. Maximum likelihood estimates of the three parameters are developed and iterative solutions are obtained with a digital computer for a population of fresh-water fish. (Auth.)

6418. Gard, Richard (Bur. Comm. Fish., Box 1155, Auke Bay, Alaska). 1963. INSULATION OF A SIERRA STREAM BY SNOW COVER. Ecology 44(1): 194-197; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9203. 1963.

At Sagehen Creek in the Sierra Nevada of California, a study was made of the effects of snow cover on temperatures above and below the snow surface. Diurnal temperatures in a vertical series, extending from the stream bed to 3 feet above the snow were determined using a thermocouple-potentiometer recording system. Maximum temperature variation was measured at a station immediately above the snow because the snow surface reradiated solar energy during the day and cold air settled to the snow at night. Snow was found to be an effective insulator of the stream and of lower snow layers. Under about 41 inches of snow, stream temperature varied between 32.00 and 32.55° F while air temperature ranged from 115.00 to 48.85° F. During the coldest period, a station 19 inches below the snow was about 44° F warmer than the air above. Snow cover may benefit fishes because it provides shelter and prevents the formation of harmful underwater ice. (Auth.)

6419. Azbelev, V. V. 1958. SOME DATA ON RETURN OF SALMON STEMMING FROM KNOWN NUMBERS OF BROOD FISH. (NEKOTORYE DANNYE PO VOZVRATU SEMGI OT IZVESTNOGO CHISLA PROIZVODITELEI.) Nauchn.-Tekh. Byul. Polyarnogo Nauchn.-Issled. Inst. Moskogo Rybn. Khoz. i Okeanog. 2(6): 53-55; Referat. Zhur., Biol., 1959, No. 58379; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9238. 1963.

Observations made in 1945-49 in the Tuloma and Kolvits Rivers show that the coefficient of salmon return varies within the limits of 1:1.67 to 1:7.34 (average - 1:4.20). These differences are due to variations in environmental conditions of salmon schools in rivers. The water level plays a particularly important role during the first year of life. (Courtesy NSF (PL 83-480) 1963.)

6420. Ratledge, Hayden M. (North Carolina Wildl. Resources Comm., Raleigh). 1963. PREIMPOUNDMENT STUDY OF THE FRENCH BROAD RIVER WATERSHED, 1962: ANTICIPATED EFFECTS OF THE PRESENCE OF PONDS ON TROUT STREAMS IN TRANSYLVANIA AND HENDERSON COUNTIES, NORTH CAROLINA. The Journal of the Elisha Mitchell Scientific Society, Vol. 79, No. 2, pp. 142-147.

In 1962 the U. S. Soil Conservation Service proposed a PL 566 small watershed flood control program for the headwaters of the French Broad River in North Carolina. Twenty-four dams creating impoundments varying from several to 100 acres are involved. As the streams in the watershed constitute some of the best trout habitat in the state, a physical, chemical and biological study was made by the North Carolina Wildlife Resources Commission to determine the effects on the trout fishery. It can be anticipated that the proposed flood control impoundments will increase the temperature below the impoundments approximately 13° F. The loss in miles of trout streams will be approximately 50 percent. Centrarchids are expected to become established in the impoundments to an extent that they would be detrimental to the upstream aspects of the remaining trout habitat. An alternate proposal of "dry dam" construction is presented.

6421. Doi, Takayuki (Tokai Reg. Fish. Res. Lab., Tokai, Japan). 1962. ON THE REPRODUCTION CURVES AND OPTIMUM ESCAPEMENTS FOR THE SOCKEYE SALMON STOCKS OF THE SKEENA RIVER, THE FRASER RIVER AND BRISTOL BAY AND THE PINK SALMON STOCKS OF ALASKA. Internatl. North Pacific Fish. Comm. Bull. 10. 155-160; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9252. 1963.

6422. Dowell, Virgil E. (State Coll. Iowa, Cedar Falls). 1962. DISTRIBUTION OF THE BLACKNOSE SHINER, NOTROPIS HETEROLEPIS EIGENMANN AND EIGENMANN, IN CLAY, DICKINSON AND OSCEOLA COUNTIES, IOWA. Proc. Iowa Acad. Sci. 69: 529-531; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9253. 1963.

Four collections of the blacknose shiner were made from 3 different streams in Clay, Dickinson and Osceola Counties, Iowa. Twenty-six specimens were collected. These are the only known specimens of this species collected from a stream environment in Iowa in the last 20 years. (Auth.)

6423. Godfrey, H. (Fish. Res. Bd. of Canada, Nanaimo, B. C., Canada). 1961. METHOD USED TO DISTINGUISH BETWEEN IMMATURE AND MATURING SOCKEYE AND CHUM SALMON TAKEN BY CANADIAN EXPLORATORY FISHING VESSELS IN THE GULF OF ALASKA. Bull. Internatl. North Pacific Fish. Comm. 5. 17-25; Biological Abstracts Vol. 44, No. 3, Abst. No. 9258. 1963.

Immature and maturing sockeye and chum salmon were distinguished on the basis of an index of maturity, which was the ratio of the weight of the gonads to the total body weight. Among fish classified as "immature" the index remained low and relatively constant throughout the fishing season (May-August). Among "maturing" fish the index increased sharply during the same period. Arbitrary limits of the index were proposed to separate the two kinds of fish. The method does not permit positive identification of maturity in the case of

"immature" fish taken very early in the season that might have begun to mature at a later date had they not been caught. (Auth.)

6424. Harrison, Harry M. (Biol. Sect., Iowa Conserv. Comm., Madrid). 1962. CREEL CENSUS OF DES MOINES RIVER FISHERMEN IN BOONE, DALLAS, AND POLK COUNTIES, IOWA. Proc. Iowa Acad. Sci. 69: 277-285; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9260. 1963.

Creel censuses were conducted on the Des Moines River during the open water seasons, usually April through November, from 1953 through 1961. The data indicated a relatively constant catch of fish. The rate of annual catch varied between a minimum of 0.26 and a maximum of 0.61 fish per fisherman-hour. The data were also analyzed by "proficiency categories" involving (1) all fishermen, (2) fishermen with one fish, (3) fishermen with two fish, and (4) fishermen with three or more fish. The most proficient fishermen (those with three or more fish at the time of interview) constituted 13% of all anglers, and caught 65% of all fish. The average length of the angler day for the census period was 2.3 hours. Channel catfish, carp, bullheads, and walleye pike, in that order, were the important fish taken. Fisherman aptitude or skill is concluded to be the significant factor related to both the catch of fish and the rate at which they are caught. (Auth.)

6425. Ivlev, V. S. 1958. ECOLOGICAL AND PHYSIOLOGICAL ANALYSIS OF FISH DISTRIBUTION IN ENVIRONMENTAL GRADIENTS. (EKOLOGO-FIZIOLOGICHESKII ANALIZ RASPREDELENIYA RYB V GRADIENTNYKH USLOVIYAKH SREDY.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 288-296; Referat. Zhur., Biol., 1959, No. 71778; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9265. 1963.

It is suggested that the temperature zone actively preferred by the animals be called the "preferred temperature." Most authors assume that the temperature at which the fish are found determines to a certain extent the zone of preferred temperature. Some authors draw opposite conclusions. The preferred temperature corresponds to the ecological concept of "optimum", which is used for animals found in a certain physiological state. Examination of this problem is limited in most works to one index: the mean or modal temperature, characterized by the highest fish frequency. Examination of the whole distribution curve permits a quantitative evaluation of additional aspects of the relationship between fish population distribution and temperature. A method of quantitative evaluation of the euryor stenothermality of fish is proposed, as well as the extent and the trends of relationship of fish to higher or lower temperatures on each side of the modal temperature. (Courtesy of NSF (PL 83-480) 1963.)

6426. Mayhew, J. K. (State Conserv. Comm., Chariton, Iowa), and Sylvan T. Runkel. 1962. THE CONTROL OF NUISANCE AQUATIC VEGETATION WITH BLACK POLYETHYLENE PLASTIC. Proc. Iowa Acad. Sci. 69: 302-307; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9278. 1963.

Large sheets of black polyethylene plastic were used to control nuisance aquatic vegetation in small farm ponds and lakes. The plastic was floated over vegetation beds and left unattended for a predetermined number of days. Adequate control of all species of Potamogeton was achieved in 10 to 18 days. Ceratophyllum demersum was eliminated in the control plots in 18 to 28 days. Control was unsuccessful for Chara vulgaris and Saggattarius (Sagittaria) latifolia. All control plots were revegetated with filamentous algae within 30 days after the covering was removed. (Authors)

6427. Menasveta, Deb. 1963. EFFECTS OF INTERRACIAL HYBRIDIZATION ON GROWTH, MORTALITY, AND YIELD OF RAINBOW TROUT (SALMO GAIRDNERI, RICHARDSON). Dissert. Absts. 23(8): 2644; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9281. 1963.

6428. Nikolsky, G. V. 1963. THE ECOLOGY OF FISHES. Academic Press, Inc. (New York 3, N. Y.), 352 pp.; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9286. 1963.

This is an expansion of Nikolsky's 1944 book entitled "The Biology of Fishes" in which most of the chapters have been rewritten and a number of new chapters added. There is a short introduction in which the basic theoretical concepts of modern fish ecology are examined and general definitions are developed. This is followed by a thorough discussion of the interrelationships between fishes and their abiotic and biotic environments. The next part consists of a description of the fundamental links in the life cycles of fishes, including reproduction and development, population dynamics, migrations, and hibernation. The final part deals with the significance of fisheries in the life of mankind and the biological basis of a rational fishery. There are abundant illustrations, a bibliography with more than 300 references, and a subject index. This book should be of considerable interest to all persons interested in fishes from the standpoint of ichthyology, conservation, or commercial fishing. (C. C. S., Jr.)

6429. Ridgway, George J., and George W. Klontz (Biol. Lab., Bur. Comm. Fish., Seattle, Wash.) 1961. BLOOD TYPES IN PACIFIC SALMON. Bull. Internatl. N. Pacific Fish. Comm. 5. 49-55; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9303. 1963.

Intraspecific differences in erythrocyte antigens (blood types) were shown to occur in 4 species: sockeye (Oncorhynchus nerka), chinook (O. tshawytscha), chum (O. keta), and pink (O. gorbuscha). Antisalmon-erythrocyte sera prepared in rabbits and chickens were used after absorption of species-specific antibodies. Some of these blood types were shown to differ in their frequency of occurrence

between different geographic races. In addition, isoimmunizations were conducted on one race of sockeye. Antisera of seven different specificities were prepared and at least 8 different patterns of antigenic composition were displayed by the cells tested. These results indicate that considerable antigenic diversity exists in salmon. Reagents to detect valuable markers for the investigation of geographic races of salmon should be obtained through further research. (Authors)

6430. Schwartz, Frank. 1963. THE FRESHWATER MINNOWS OF MARYLAND. Maryland Conserv. 40(2): 19-29; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9309. 1963.

6431. Tanaka, Soichi (Tokai Reg. Fish. Res. Lab., Tokai, Japan). 1962. STUDIES OF THE QUESTION OF REPRODUCTION OF SALMON STOCKS. Internatl. North Pacific Fish. Comm. Bull. 10. 123-128; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9315. 1963.

6432. Vasil'ev, I. S. 1959. THE ADAPTIVE SIGNIFICANCE OF THE STRUCTURE OF SPAWNING REDDS IN SALMON OF THE GENUS ONCORHYNCHUS. (OB ADAPTIVNOM ZNACHENII STROENIYA NERESTOVYKH BUGROV LOSOSEI RODA ONCORHYNCHUS.) Zhur. Obshchei Biol. 20(2): 155-160; Referat. Zhur., Biol., 1960, No. 2085; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9320. 1963.

The egg deposition of pink salmon and summer chum salmon on large pebbles and the presence in each redd of several individual nests ensures better conditions of gas exchange and reduces the probability of loss of eggs when the redd freezes. Burial of the eggs 15-30 cm deep protects them from damage during displacement of the bottom in fast streams, from freezing, drying up, and accumulation of mud. Owing to the large area occupied by the redds, the bottom surrounding the eggs is aerated and percolation of the water is intensified. (Courtesy NSF (PL 83-480) 1963.)

6433. Zhadin, V. I., A. G. Rodina and A. S. Troshin. 1958. A STUDY OF THE BIOLOGICAL PRODUCTIVITY OF BODIES OF WATER USING RADIOACTIVE ISOTOPES. (IZUCHENIE BIOLOGICHESKOI PRODUKTIVNOSTI VODOEMOV PRI POMOSHCHI RADIOIZOTOPOV.) Akad. Nauk SSSR: Moscow. 194-198; Referat. Zhur., Biol., 1959, No. 61048; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9328. 1963.

With the aid of P^{32} and Ca^{45}, the biological productivity of bodies of water was studied following the introduction of mineral and organic fertilizers. P^{32} is least absorbed by a sandy bottom and most absorbed by a peat bottom. P^{32} from the water and the bottom is rapidly used up by bacteria and phytoplankton. The presence of higher plants rapidly using P^{32} sharply changes its distribution. P^{32} is accumulated by zooplankton, epiphytic algae, and higher plants. Data are given on the rate of accumulation of P^{32} and Ca^{45}. Recommendations concerning time and manner of fertilizing are based on the foregoing facts. (Courtesy of NSF (PL 83-480) 1963.)

6434. Randall, D. J., and G. Shelton (Dept. Zool., Univ. Southampton, Southampton, England). 1963. THE EFFECTS OF CHANGES IN ENVIRONMENTAL GAS CONCENTRATIONS ON THE BREATHING AND HEART RATE OF A TELEOST FISH (TINCA TINCA). Comp. Biochem. and Physiol. 9(3): 229-239; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9539. 1963.

Oxygen lack stimulates the tench to increase the frequency and amplitude of the breathing movements and raise the ventilation volume. The heart rate stays constant during these changes until the oxygen concentration falls below 3 mg/l. At this point reflex inhibition of the heart begins and the rate falls progressively. Carbon dioxide excess causes an increase in ventilation volume by virtue of a greater depth of breathing, the frequency decreasing slightly. The heart rate goes up with increasing carbon dioxide concentrations. The significance of these responses is discussed. The heart rate decreases when the oxygen gradient between ventilation stream and blood is too small to completely saturate the blood at the original flow rate. The increase in heart rate in the presence of carbon dioxide offsets the Bohr effect and allows a slightly higher oxygen consumption. The change in ventilation in the presence of carbon dioxide is considered to have little importance in satisfying the respiratory requirements of the animal. (Authors)

6435. Ostroumova, I. N. 1958. THE FORMED BLOOD ELEMENTS IN THE DEVELOPMENT OF THE SALMON. (FORMENNYE ELEMENTY KROVI V RAZVITII LOSOSYA.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 380-386; Referat. Zhur., Biol., 1959, No. 49304; Biological Abstracts, Vol. 44, No. 3, Abst. No. 9977. 1963.

The paper deals with changes in the formed blood elements in postembryonic salmon. Primary erythrocytes are characteristic during yolk feeding, the first immature forms appearing only at the end of this period. During the time of mixed feeding primary erythrocytes, immature young forms of erythropoiesis (they constitute 30 to 35% of all blood cells), and secondary erythrocytes are found in the blood. Secondary erythrocytes and their immature forms are found in the blood in fairly great numbers (25 to 30%) when the yolk sac is completely absorbed and the young change to entire active feeding. (Courtesy NSF (PL 83-480) 1963.)

6436. Serbenyuk, Ts. V., and Yu. B. Maiteifel'. 1958. THE EFFECT OF TEMPERATURE ON THE PHYSIOLOGICAL MECHANISM OF FISH. (K VOPROSU O FIZIOLOGICHESKOM MEKHANIZME DEISTVIYA TEMPERATURY NA RYB.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 278-287; Referat. Zhur., Biol., 1959, No. 79950; Biological Abstracts, Vol. 44, No. 3, Abst. No. 10963. 1963.

The role of the central nervous system in the

physiological changes of the fish organism during the change in environmental temperature was studied. Upon transfer of chubs and crucian carp from a temperature of 14-15° C to 5-6° C, the O_2 consumption by brain tissue decreased on the 2nd or 3rd day by 48 and 42%, respectively. The O_2 consumption by muscle tissue remained practically unchanged. Upon transfer of fish from water of a temperature of 14-15° C to 21-23° C, the respiratory metabolism of brain tissue increased in both species by 50%, while that of the muscle remained unaltered. After operation (section of the spinal cord just posterior to the oblongata) transfer of fish from 14-15° C to 516° C caused a decreased O_2 consumption in brain tissue by 70%, and in muscle tissue by 50%. After transfer of the operated fish from 14-15° C to 21-23° C, the O_2 consumption by both brain and muscle tissues increased in parallel in both species. It appeared that within the limits of the temperatures studied the brain of the chub and of the crucian carp regulated the respiratory metabolism of the muscle tissue, maintaining it on a certain level. During prolonged temperature adaptation (1 1/2 months) the O_2 consumption of the brain and muscle tissues changed, and the dependence of the O_2 consumption by brain tissue on the temperature changed; the O_2 consumption by chubs and crucian carps at 12-13° C was higher by 40% than at 19-25° C. During the temperature adaptation the biochemical changes in brain and muscle tissues of fish proceeded in 2 phases: at first, rapid changes took place in the brain without any significant changes in the muscles; in the second phase, prolonged adaptational changes occurred in both brain and muscle tissues. (Courtesy of NSF (PL 83-480) 1963.)

6437. Baburina, E. A. 1958. PECULIARITIES IN THE DEVELOPMENT OF THE EYES AND THEIR FUNCTION IN FISH. (OSOBENNOSTI RAZVITIYA GLAZ I IKH FUNKTSII U RYB.) Tr. Sovesch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 101-110; Referat. Zhur., Biol., 1959, No. 49306; Biological Abstracts, Vol. 44, No. 3, Abst. No. 11346. 1963.

The development of the eyes in connection with the relation to light, peculiarities of sight, and behavior have been studied in fish belonging to various ecological groups. Of the cyprinid fish, eye development was studied in representatives of phytophilous, pelagophilous, ostracophilous, and lithophilous fishes. Eye development in some acipenserids and percid fish was also investigated. Eye development and their function is characteristic for each ecological group because of the close connection of the development of every organ with the relations between the organism and its environment. Basic changes in the structure and function of the eyes occur during the passage from one stage of development to the other, simultaneously with basic changes in other organs. The structure and function of the eyes, as well as the structure and function of other organs and the biology of the organism, does not change much during each stage of development. (Courtesy NSF (PL 83-480) 1963.)

6438. Baburina, E. A. 1957. DEVELOPMENT OF THE EYES AND THEIR FUNCTION IN THE RUSSIAN STURGEON AND THE STARRED STURGEON. (RAZVITIE GLAZ I IKH FUNKTSII U OSETRA I SEVRYUGI.) Tr. Inst. Morfol. Zhivotnykh Akad. Nauk SSSR 20. 148-186; Referat. Zhur., Biol., 1959, No. 88767; Biological Abstracts, Vol. 44, No. 3, Abst. No. 11347. 1963.

A description by stages (according to V. V. Vasnetsov) of the development of the eyes in the Russian sturgeon and the starred sturgeon (the author recognizes 8 stages in the embryonic development and 2 stages in the larval) this description is a result of a histological study of the eyes of embryos, larvae, fry, young, and adult Russian sturgeons and embryos, larvae, and adult starred sturgeons. The changes in eye structure during development has an adaptive character; according to the difference in the eye structure the vision of the Russian sturgeon is adapted to poorer illumination than that of the starred sturgeon. Practical recommendations for pisciculture are given. (Courtesy NSF (PL 83-480) 1963.)

6439. Yamagami, Kenjiro, and Hideo Mohri (Coll. Gen. Edu. Tokyo, Tokyo, Japan). 1962. PHOSPHORUS METABOLISM IN FISH EGGS. IV. COLUMN CHROMATOGRAPHIC SEPARATION OF PHOSPHOLIPIDS IN THE RAINBOW TROUT DURING EMBRYONIC AND POSTEMBRYONIC DEVELOPMENT. Sci. Papers Coll. Gen. Edu. Univ. Tokyo Biol. Pt. 12(2): 233-240; Biological Abstracts, Vol. 44, No. 3, Abst. No. 11363. 1963.

Phospholipid mixtures from the whole eggs (or alevins) and the separated embryos of Salmo gairdneri irideus were fractionated with silicic acid column chromatography. Identification of each component fractionated was also made with silica paper chromatography. In unfertilized eggs, phospholipids were fractionated into 7 large components, 1 cephalin (mainly phosphatidylethanolamine), 4 lecithins, 1 sphingomyelin and 1 unknown component. The elution patterns obtained with whole eggs at all stages before hatching were almost identical. No significant change was observed at fertilization. After hatching, a considerable decrease occurred in 1 lecithin component, which disappeared completely at the end of the sac-fry stage. Other components did not show any significant decrease during development. In a later phase of development, lysolecithin appeared in egg yolk. In embryonic tissues, an active formation of phospholipids took place except lysolecithin and the lecithin component which decreased after hatching. (Authors)

6440. Kostomarova, A. A. 1961. THE SIGNIFICANCE OF THE STAGE OF MIXED FEEDING FOR THE SURVIVAL OF ESOX LUCIUS L. LARVAE. (ZHACHENIE ETAPA SMESHANNOGO PITANIYA DLYA VYZHIVAEMOSTI LICHINOK SHCHUKI.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR

13. 344-347; Referat. Zhur., Biol., 1962, No. 17I11; Biological Abstracts, Vol. 44, No. 3, Abst. No. 11374. 1963.

Growth of two groups of Esox Lucius L. (EL) larvae in differing nutritive conditions is studied: (I) received food from the time they transferred to live food (Infusoria, cyclops, cladoceran dotted Cymatoa), and (II) developed only on the yolk sac. In (I), at the time of resorption of the yolk sac, the mouth was elongated, the pectoral and rudimentary abdominal fins are expanded out of the common fin crease, the spinal and anal lobes evolved, and the caudal lobe became heterocercal. In the composition of the endoskeleton of the spinal and anal lobes, cartilaginous rudiments of pterihyophores were formed and musculature of the rays were differentiated. Morphologically, the stomach was isolated and the intestinal loop was blocked off. In (II), the mouth remained short, pectoral and rudimentary abdominal fins did not expand, the common fin folds were not differentiated, and the caudal lobe remained homocercal. In the composition of the endoskeleton, only a mesenchymal blasteme was formed from rudimentary pterihyophores at the prochondral stage of development. The stomach was not morphologically separated, and the intestinal loop was not blocked off. The larvae of (II) lost the ability to react to water currents. In the absence of external food all the larvae perished from hunger in the course of 3 days following resorption of the yolk sac.

****

ABSTRACTERS OTHER THAN AUTHORS AND STAFF:

Biological Abstracts
M. Das
S. P. Davis
M. V. Dianzani
D. V. Ellis
G. A. Emerson
B. J. Flood
Isiah Gellman
J. Grauman
H. Hahn
K. E. Marshall
National Science Foundation
S. M. B. Pieper
J. G. Scully
W. N. Sparhawk
C. C. Sturgis, Jr.

AUTHOR INDEX

Abakumov, V. A.
Methods of studying changes in increments of weight and length in fishes. (Metodika izucheniya dinamiki vesovogo i lineinogo prirosta ryb.) 6284

Ali, M. A.
Some aspects of the retinal physiology of salmon (Salmo salar). 6406

Allison, Don, Burton J. Kallman, and Oliver B. Cope.
Insecticides: effects on cutthroat trout of repeated exposure to DDT. 6235

Andersen, John K. (See Edwin L. Cooper) 6348

Andrews, A. K. (See W. R. Bridges) 6352

Andrews, C. W. (See A. T. Pinhorn) 6268

Anonymous.
Wildlife research progress (in the United States) 1961. 6416

Arora, H. L., and R. W. Sperry.
Color discrimination after optic nerve regeneration in the fish Astronotus ocellatus. 6379

Arve, John.
Experiments with "chemical dams." 6285

Ashley, Laurence M., and John E. Halver.
Multiple metastasis of rainbow trout hepatoma. 6344

Assman, A.
Accessibility of chironomid larvae to fish. (O dostupnosti lichinok khironomid dlya ryb.) 6286

Axelrod, H. (See M. S. Mulla) 6374

Azbelev, V. V.
Some data on return of salmon stemming from known numbers of brood fish. (Nekotorye dannye po vozvratu semgi ot izvestnogo chisla proizvoditelei.) 6419

Baburina, E. A.
Peculiarities in the development of the eyes and their function in fish. (Osobennosti razvitiya glaz i ikh funktsii u ryb.) 6437
Development of the eyes and their function in the Russian sturgeon and the starred sturgeon. (Razvitie glaz i ikh funktsii u osetra i sevryugi.) 6438

Baldwin, Norman S., and Robert W. Saalfeld.
Commercial fish production in the Great Lakes 1867-1960. 6287

Barry, Edwin M.
Inland Fish Management. (Annual Report of the Maryland Game and Inland Fish Commission.) 6277

Bé, Allan W. H.
(See William H. Hamlin) 6236
Quantitative multiple opening-and-closing plankton samplers. 6358

Bell, Robert R.
Preliminary age determination of bluefin tuna, Thunnus thynnus. 6259

Berezina, N.
Control of predatory aquatic insects. (Bor'ba khishchnymi vodnymi nasekomymi.) 6288

Biostatistical Section.
The California marine fish catch for 1961. 6366

Bishop, Robert D. (See Billy B. Carroll) 6343

Bodenstein, G., and G. Müller-Bastgen.
Investigations on the toxicity of some herbicides for fishes. (Untersuchungen über die toxizität einiger herbizide fur fische.) 6367

Bolster, C. L.
Summary of aquathol test results. 6326

Borgeson, David P.
A rapid method for food-habits studies. 6355

Borshosh, A. V., and V. V. Illesh.
Elimination of Ichthyophthirius from fish ponds. (Ozdorovlenie vodoemov ot ikhtiofti-rioza ryb.) 6289

Bridges, W. R., B. J. Kallman, and A. K. Andrews.
Persistence of DDT and its metabolites in a farm pond. 6352

Brown, V. M. (See W. L. Templeton) 6398

Buchholz, Marvin M., and Kenneth D. Carlander.
Failure of yellow bass, Roccus mississippiensis, to form annuli. 6347

Budrick, R. (See D. C. Noll) 6327

Bullock, G. L., and A. J. Ross.
Crystal formation in furunculosis agar. 6249

Burdick, G. E.
Chemical control of aquatic vegetation in relation to the conservation of fish and wildlife. 6328

Burmakin, E. V.
Results of work on depopulating (the fish of) two lakes in the Leningrad Oblast. (Rezul'taty rabot po obezryblivaniyu dvukh ozer Leningradskoi Oblasti.) 6387

Carlander, Kenneth D. (See Marvin M. Buchholz) 6347

Carroll, Billy B., Gordon E. Hall, and Robert D. Bishop.
Three seasons of rough fish removal at Norris Reservoir, Tennessee. 6343

Carson, Rachel.
Poisoned waters kill our fish and wildlife. 6415

Carufel, Louis H.
Life history of saugers in Garrison Reservoir. 6265

Castellanos, P. C.
Aquatic weed control and related problems at Lake Mohawk, New Jersey. A private lake community. 6333

Ceretto, F. (See P. Ghittino) 6403

Chernova, N. A.
Method of study of alimentary and defense conditioned reflexes in fish. (Metodika izucheniya pishchevykh i oboronitel'nykh uslovnykh reflek-sov u ryb.) 6378

Christie, W. J. (See W. B. Scott) 6266

Chubb, James C.
On the characterization of the parasite fauna

of the fish of Llyn Tegid. 6316
Clemens, Howard P. (See Kermit E. Sneed) 6312
Cooley, Richard Allen.
Decline of the Alaska salmon. A case study in resource conservation policy. 6368
Cooper, Edwin L., Herbert Hidu, and John K. Andersen.
Growth and production of largemouth bass in a small pond. 6348
Cope, Oliver B. (See Don Allison) 6235
Cortell, J. M.
Progress report on the field testing of various herbicides for aquatic weed control. 6325
Cramer, Frederick K., and Ivan J. Donaldson.
Evolution of recovery nets used in tests on fish passage through hydraulic turbines. 6252
Crandall, Catherine A., and Clarence J. Goodnight.
The effects of sublethal concentrations of several toxicants to the common guppy, Lebistes reticulatus. 6402

Dahl, Jørgen.
Studies on the biology of Danish stream fishes. I. The food of grayling (Thymallus thymallus) in some Jutland streams. 6369
Darnell, Rezneat M.
Nitrogen turnover in an estuarine fish population. 6411
Davies, D. M. (See V. K. S. Iyengar) 6240
Davis, James T. (See Janice S. Hughes) 6370
Dendy, J. S.
Observations on bryozoan ecology in farm ponds. 6243
Derse, Philip H., and F. M. Strong.
Toxicity of antimycin to fish. 6237
Devi, Katragadda Vijaya Lakshmi.
The effects of turbidity and of light on the toxicity of two rotenone formulations to the fathead minnow (Pimephales promelas). 6290
Dinsmore, James J.
Life history of the creek chub, with emphasis on growth. 6262
Doi, Takayuki.
On the predatory and competitive relationships among fishes caught in the waters adjacent to Japan. 6291
On the reproduction curves and optimum escapements for the sockeye salmon stocks of the Skeena River, the Fraser River and Bristol Bay and the pink salmon stocks of Alaska. 6421
Donaldson, Ivan J. (See Frederick K. Cramer) 6252
Doudoroff, Peter. (See Stuart J. Silver) 6341
Dowell, Virgil E.
Distribution of the blacknose shiner, Notropis heterolepis Eigenmann and Eigenmann, in Clay, Dickinson and Osceola Counties, Iowa. 6422
Dragovich, Alexander, John H. Finucane, John A. Kelly, Jr., and Billie Z. May.
Counts of red-tide organisms, Gymnodinium breve, and associated oceanographic data from Florida West Coast, 1960-61. 6318
Dryagin, P. A.
Biological bases of controlled formation of fish stocks in reservoirs. (Biologicheskei osnovy napravlennogo formirovaniya rybnykh resursov v vodokhranilishchakh.) 6292
Basic problems in the development of the lake fishing industry in the USSR. (Osnovnye zadachi razvitiya ozernogo rybnogo khozyaistva v SSR.) 6388
du Plooy, A. (See G. Lenhard) 6281

Eremeeva, E. F.
Development by stage and the dynamics of fish abundance. (Etapnost' razvitiya i dinamika chislennosti ryb.) 6293

Fagerlund, U. H. M. (See H. S. Sehdev) 6273
Fagerlund, U. H. M., J. R. McBride, M. Smith, and N. Tomlinson.
Olfactory perception in migrating salmon. III. Stimulants for adult sockeye salmon (Oncorhynchus nerka) in home stream waters. 6275
Fink, Bernard D. (See Craig J. Orange) 6260
Finucane, John H. (See Alexander Dragovich) 6318
Follenius E.
Comparative study of the fine cytology of the preoptic nucleus and of the lateral tuberales nucleus in the trout (Salmo irideus Gibb.) and in the perch (Perca fluviatilis). Comparison of the two types of neurosecretion. (Étude comparative de la cytologie fine du noyau préoptique (NPO) et du noyau latéral du tuber (NLT) chez la truite (Salmo irideus Gibb.) et chez la perche (Perca fluviatilis). Comparaison des deux types de neurosécrétion.) 6308
Foster, Neal R.
Reproductive behavior patterns and functional anatomy of some American oviparous cyprinodont fishes. 6408
Frey, David G.
Limnology in North America. 6386
Fromm, P. O. (See W. L. Gross) 6349
Fromm, P. O., and R. M. Stokes.
Assimilation and metabolism of chromium by trout. 6389

Gard, Richard.
Insulation of a Sierra stream by snow cover. 6418
Gaver, Frank E.
A water-powered automatic fry feeder. 6255
Gaylor, J. Y. (See A. Houser) 6322
Ghittino, P., and F. Ceretto.
Study of the etiopathogenesis of hepatoma in hatchery rainbow trout. (Studio sulla eziopatogenesi dell'epatoma della trota iridea di allevamento.) 6403
Godfrey, H.
Method used to distinguish between immature and maturing sockeye and chum salmon taken by Canadian exploratory fishing vessels in the Gulf of Alaska. 6423

Goodell, B. C.
A reappraisal of precipitation interception by plants and attendant water loss. 6384
Goodnight, Clarence J. (See Catherine A. Crandall) 6402
Goryunova, S. V.
Luminescent analysis methods in studies of problems on primary productivity. (Metody lyuminestsentnogo analiza pri izuchenii voprosov pervichnoi produktsii.) 6278
Gross, W. L., P. O. Fromm, and E. W. Roelofs.
Relationship between thyroid and growth in green sunfish, Lepomis cyanellus (Rafinesque). 6349
Grygierek, Eugenia.
The effect of increasing the carp fry density on crustacean plankton. (Wplyw zageszczenia narybku karpi na faune skorupiakow planktonowych.) 6390
Gulland, J. A.
The application of mathematical models to fish populations. 6391
Guse, L. R.
Aquatic weed control research in Indiana. 6338
Guse, Lynn Robert.
Physiological and residual studies of herbicides for aquatic weed control. 6404

Hall, Gordon E. (See Billy B. Carroll) 6343
Halver, John E. (See Laurence M. Ashley) 6344
Hamlin, William H., and Allan W. B. Bé.
A plankton picker. 6236
Hammer, Glen L. (See Arthur M. Phillips, Jr.) 6248
Harrison, Harry M.
Creel census of Des Moines River fishermen in Boone, Dallas, and Polk Counties, Iowa. 6424
Hayden, Robert P., and Robert D. Ringo.
Introduction of Palaemonetes paludosus, a fresh-water shrimp, into the lower Colorado River. 6258
Heist, Carroll E. (See George E. Krantz) 6245
Herbert, D. W. M.
The toxicity to rainbow trout (Salmo gairdneri) of spent still liquors from the distillation of coal. 6294
Heubach, William, Robert J. Toth, and Alan M. McCready.
Food of young-of-the-year striped bass (Roccus saxatilis) in the Sacramento-San Joaquin River system. 6256
Hidu, Herbert. (See Edwin L. Cooper) 6348
Hiltibran, R. C.
Aquatic weed control research in central Illinois. 6337
Hoffman, Dale Arthur.
The concentration and accumulation of radioactive phosphorus by an aquatic food chain. 6362
Höhnk, W.
Publications of the Institute of Oceanology in Bremerhaven. Suppl. Third marine biological symposium, October 23-25th, 1962, in Bremerhaven. (Veroeffentlichungen des Instituts fur Meeresforschung in Bremerhaven. Sonderband. Drittes meeresbiologische symposion 23. bis 25. Oktober 1962 in Bremerhaven.) 6361
Holbert, Leon R.
Taste and odor experiences using rotenone products (in lakes). 6295
Hoopes, David Townsend.
Ecological distribution of spawning sockeye salmon (Oncorhynchus nerka) in three lateral streams, Brooks Lake, Alaska. 6296
Horrocks, A. W., and R. F. Smith.
Control of Eurasian milfoil, Myriophyllum spicatum, in Lake Hopatoong, New Jersey. 6330
Houser, A., and J. Y. Gaylor.
Results of endothal and two formulations of Silvex for the control of aquatic plants in Oklahoma. 6322
Houston, Arthur H., and Lawrence T. Threadgold.
Body fluid regulation in smolting Atlantic salmon. 6269
Huchson, D. R., and J. M. Sheppard.
Some SCUBA observations for the fresh-water angler. 6238
Hughes, Janice S., and James T. Davis.
Variations in toxicity to bluegill sunfish of phenoxy herbicides. 6370
Hynes, H. B. N., and F. W. Roberts.
The biological effects of synthetic detergents in the River Lee, Hertfordshire. 6279

Illesh, V. V. (See A. V. Borshosh) 6289
International North Pacific Fisheries Commission.
Annual Report 1961. 6356
Isaak, L. W. (See M. S. Mulla) 6374
Ivanova, M. B.
Use of the chlorophyll method in studying the primary productivity of a dystrophic lake. (Primenenie khlorofil'nogo metoda pri izuchenii pervichnoi produktivnosti distrofnogo ozera.) 6280
Ivlev, V. S.
Utilization of food by planktophagous fish. (Ob utilizatsii pishchi rybami-planktofagami.) 6297
Ecological and physiological analysis of fish distribution in environmental gradients. (Ekologo-fiziologicheskii analiz raspredeleniya ryb v gradientnykh usloviyakh sredy.) 6425
Iyengar, V. K. S., D. M. Davies, and H. Kleerekoper.
Some relationships between Chironomidae and their substrate in nine fresh-water lakes of southern Ontario, Canada. 6240

Johnson, C. L. (See Gilles La Roche) 6407
Johnson, D. S., and Maureen H. H. Soong.
The fate of introduced fresh-water fish in Malaya. 6414
Johnson, R. P.
Studies on the life history and ecology of the bigmouth buffalo, Ictiobus cyprinellus (Valenciennes). 6271

Jones, F. R. Harden.
The reaction of fish to moving backgrounds. 6244
Junge, Charles O., Jr., and Lloyd A. Phinney.
Factors influencing the return of fall chinook salmon (Oncorhynchus tshawytscha) to Spring Creek Hatchery. 6319

Kallman, B. J. (See W. R. Bridges) 6352
Kallman, Burton J. (See Don Allison) 6235
Kelley, John A., Jr. (See Alexander Dragovich) 6318
Kipper, Z. M.
Use of navigation locks at hydroelectric stations for the passage of fish from downstream into the reservoir. (Ob ispol'zovanii sudokhodnykh shlyuzov GES dlya propuska ryby iz nizhnego b'efa v vodokhranilishche.) 6298
Kisch, Bruno, and Delbert E. Philpott.
Electron microscopy of the heart of fish. I. The goldfish heart. 6399
Electron microscopy of the heart of fish. II. The heart of selachians (dogfish and torpedo). 6400
Kitahara, Mitsuru. (See Keiichi Kondo) 6309
Kleerekoper, H. (See V. K. S. Iyengar) 6240
Klontz, George W. (See George J. Ridgway) 6429
Knight, Alexis E.
The embryonic and larval development of the rainbow trout. 6342
Kondo, Keiichi, and Mitsuru Kitahara.
A note on scales of the chum salmon and allied species. 6309
Kostomarova, A. A.
The significance of the stage of mixed feeding for the survival of Esox lucius L. larvae. (Zhachenie etapa smeshannogo pitaniya dlya vyzhivaemosti lichinok shchuki.) 6440
Krantz, George E., Jack M. Reddecliff, and Carroll E. Heist.
Immune response of trout to Aeromonas salmonicida. Part I. Development of agglutinating antibodies and protective immunity. 6245
Kutkuhn, Joseph H.
Estimating absolute age composition of California salmon landings. 6371

Larimore, R. Weldon, and Philip W. Smith.
The fishes of Champaign County, Illinois, as affected by 60 years of stream changes. 6372
Larkins, Herbert A.
Comparison of salmon catches in monofilament and multifilament gill nets. 6373
La Roche, Gilles, C. L. Johnson, A. N. Woodall, and L. L. Rosenberg.
Iodine metabolism in adult king salmon (Oncorhynchus tshawytscha, Walbaum). 6407
Larsen, Howard N.
Comparison of various methods of hemoglobin determination on catfish blood. 6246
Lawler, G. H.
Spring stainless steel anchor tag. 6276
Lawler, G. H., and G. F. M. Smith.
Use of colored tags in fish population estimates. 6272
Lebedev, V. D.
Effect of fisheries on the biological characteristics of fishes (based on archaeological data). (Vozdeistvie promysla na biologicheskie pokazateli ryb (po arkheologicheskim materialam).) 6299
Lemke, Armond E., and Donald I. Mount.
Some effects of alkyl benzene sulfonate on the bluegill, Lepomis macrochirus. 6345
Lenhard, G., W. R. Ross, and A. du Plooy.
A study of methods for the classification of bottom deposits of natural waters. 6281
Lewis, William M., and John Nickum.
Rearing trout in raceways supplied by water from the hypolimnion of a strip mine pond. 6250
Lewis, William M., O. D. McNail, and R. C. Summerfelt.
A device for taking water samples in sterile bottles at various depths. 6359
Lindaberry, H. L.
Considerations regarding the use of aquathol in potable watersheds. 6332
Lindstrom, Thorolf, and Nils-Arvid Nilsson.
On the competition between whitefish species. 6392
Ludemann, D., and H. Neumann.
The effect of modern contact insecticides on fresh-water fauna. (Uber die wirkung der neuzeitlichen kontaktinsektizide auf die tiere des susswassers.) 6393
Lynch, A. D. (See K. M. Madden) 6394
Lyubitskaya', A. I.
Effect of visible light, ultraviolet rays and temperature on body metamerism of fish. I. Effect of different parts of the visible spectrum, darkness and temperature on survival and body metamerism of fish. (Vliyanie vidimogo sveta, ul'trafioletovykh luchei i temperatury na metameriyu tela ryb. I. Vliyanie razlichnykh chastei vidimogo spektra, temnoty i temperatury na vyzhivanie i metameriyu tela ryb.) 6300

Mackenthun, K. M.
Observations on the use of 2, 4-D granules in fish hatchery ponds. 6339
A review of algae, lake weeds, and nutrients. 6382
MacNichol, Edward F., Jr. (See Henry G. Wagner) 6401
Madden, K. M., and A. D. Lynch.
Notes on the first rearing and introduction of Esox masquinongy in Iowa waters. 6394
Maiteifel', Yu. B. (See Ts. V. Serbenyuk) 6436
Maltzeff, Eugene M. (See Paul D. Zimmer) 6264
Marshall, N. B.
The biology of sound-producing fishes. 6360
Matisone, M.
Primary-productivity of plankton in ponds of the Latvian SSR. (Pervichnaya produktsiya planktona v prudakh Latviiskoi SSR.) 6282
May, Billie Z. (See Alexander Dragovich) 6318

Mayhew, J. K., and Sylvan T. Runkel.
The control of nuisance aquatic vegetation with black polyethylene plastic. 6426
McBride, J. R.
(See H. S. Sehdev) 6273
(See U. H. M. Fagerlund) 6275
McCready, Alan M. (See William Heubach) 6256
McDonald, Donald Burt.
The productivity of Deer Creek Reservoir, Utah, with special reference to the phytoplankton. 6363
McNail, O. D. (See William M. Lewis) 6359
McNeil, William J.
Quality of the spawning bed as it related to survival and growth of pink salmon embryos and alevins and time of fry emergence. 6410
Meehan, William R.
A modified scoop trap for sampling downstream-migrant salmon in turbid glacial rivers. 6253
Menasveta, Deb.
Effects of interracial hybridization on growth, mortality, and yield of rainbow trout (Salmo gairdneri, Richardson). 6427
Meyer, Fred P.
Field treatments of Aeromonas liquefaciens infections in golden shiners. 6251
Michel, Curtis.
Evaporation control: a new tool for water management. 6383
Miller, Robert Rush.
Extinct, rare, and endangered American freshwater fishes. 6412
Mohri, Hideo. (See Kenjiro Yamagami) 6439
Molnar, G., and I. Tölg.
Experiments concerning gastric digestion of pikeperch (Lucioperca lucioperca L.) in relation to water temperature. 6380
Moss, D. D., and D. C. Scott.
Respiratory metabolism of fat and lean channel catfish. 6247
Mount, Donald I. (See Armond E. Lemke) 6345
Muir, Barry S.
Vital statistics of Esox masquinongy in Nogies Creek, Ontario. I. Tag loss, mortality due to tagging, and the estimate of exploitation. 6267
Mulla, M. S., L. W. Isaak, and H. Axelrod.
Field studies on the effects of insecticides on some aquatic wildlife species. 6374
Müller-Bastgen, G. (See G. Bodenstein) 6367
Muncy, Robert J., and Abe D. Oliver, Jr.
Toxicity of ten insecticides to the red crawfish, Procambarus clarki (Girard). 6353

Nandi, Jean.
The structure of the interrenal gland in teleost fishes. 6381
Neal, Richard A.
Black and white crappies in Clear Lake, 1950-1961. 6311
Neumann, H. (See D. Ludemann) 6393
New, John G.
Spawning behavior of the shield darter, Percina peltata (Pisces, Percidae). 6405
Nickum, John. (See William M. Lewis) 6250
Nikolsky, G. V.
The ecology of fishes. 6428
Nilsson, Nils-Arvid. (See Thorolf Lindstrom) 6392
Noll, D. C., and R. Budrick.
Interim report on aquatic weed control of recreational waters above potable water. 6327

Oliver, Abe D., Jr. (See Robert J. Muncy) 6353
Opalatenko, L. K.
Concerning methods of studying breathing in fish. (Do metodyky doslidzhennya dykhannya u ryb.) 6304
Orange, Craig J., and Bernard D. Fink.
Migration of a tagged bluefin tuna across the Pacific Ocean. 6260
Ostroumova, I. N.
The formed blood elements in the development of the salmon. (Formennye elementy krovi v razvitii lososya.) 6435
Otto, L.
Current bibliography for aquatic sciences and fisheries. 6385
Ozeretskovakaya, N. G. (See V. I. Zhadin) 6283

Parker, Richard A.
On the estimation of population size, mortality, and recruitment. 6417
Parker, Robert R.
On the problem of maximum yield from North Pacific sockeye salmon stocks. 6270
Effects of formalin on length and weight of fishes. 6274
Pfeiffer, W.
Alarm substances (in fish, review). 6357
Pfeiffer, Wolfgang.
The morphology of the olfactory organ of the Pacific salmon (Oncorhynchus). 6239
Phillips, Arthur M., Jr., Glen L. Hammer, and Earl A. Pyle.
Dry concentrates as complete trout foods. 6248
Philpott, Delbert E. (See Bruno Kisch) 6399, 6400
Phinney, Lloyd A. (See Charles O. Junge, Jr.) 6319
Pierce, M. E.
Progress report on the effect of Kuron applications after one and two years at Long Pond, Dutchess County, New York. 6335
A study of the effect of the weed-killer 2, 4-D Aqua Granular on six experimental plots of Long Pond, Dutchess County, N. Y. 6336
Pinhorn, A. T., and C. W. Andrews.
Effect of photoperiods on the reactions of juvenile Atlantic salmon (Salmo salar L.) to light stimuli. 6268
Porterfield, W. A. (See D. E. Seaman) 6324
Pratt, Ivan. (See Ellis J. Wyatt) 6313
Prieditis, A.
Artificial food for trout with supplements of trace substances. (Iskusstvennye korma s mikrodobavkami dlya foreli.) 6301

Pyle, Earl A. (See Arthur M. Phillips, Jr.) 6248

Randall, D. J. (See G. Shelton) 6305
Randall, D. J., and G. Shelton.
The effects of changes in environmental gas concentrations on the breathing and heart rate of a teleost fish (Tinca tinca). 6434
Ratledge, Hayden M.
Preimpoundment study of the French Broad River watershed, 1962: anticipated effects of the presence of ponds on trout streams in Transylvania and Henderson Counties, North Carolina. 6420
Reddecliff, Jack M. (See George E. Krantz) 6245
Reish, Donald J.
Mass mortality of marine organisms attributed to the "red tide" in southern California. 6257
Reshetnikov, Iu. S.
On relations between the number of gill rakers and the feeding habits of chars of the genus Salvelinus. (O svyazi mezhdu kolichestvom zhabernykh tychinok i kharakterom pitaniya u gol'tsov roda Salvelinus.) 6310
Ridgway, George J., and George W. Klontz.
Blood types in Pacific salmon. 6429
Ringo, Robert D. (See Robert P. Hayden) 6258
Roberts, F. W. (See H. B. N. Hynes) 6279
Rodina, A. G.
(See V. I. Zhadin) 6433
Microbiology of detritus of lakes. 6241
Roedel, Phil M.
The names of tunas and mackerels. 6395
Roelofs, E. W. (See W. L. Gross) 6349
Rosenberg, L. L. (See Gilles La Roche) 6407
Ross, A. J. (See G. L. Bullock) 6249
Ross, W. R. (See G. Lenhard) 6281
Rothschild, Brian J.
A critique of the scale method for determining the age of the alewife, Alosa pseudoharengus (Wilson). 6350
Runkel, Sylvan T. (See J. K. Mayhew) 6426

Saalfeld, Robert W. (See Norman S. Baldwin) 6287
Sandholm, Hollace A. (See James C. Schmulbach) 6364
Schiemenz, F.
Avoidance of damage to fish when employing sprays against agricultural pests. (Die vermeidung von schädigungen der fischerei bei der anwendung von spritzmitteln gegen landwirtschaftliche schadlinge.) 6396
Schmulbach, James C., and Hollace A. Sandholm.
Littoral bottom fauna of Lewis and Clark Reservoir. 6364
Schoumacher, Roger.
A projection machine for examining fish scales. 6254
Schwartz, Frank.
The fresh-water minnows of Maryland. 6430
Scott, D. C. (See D. D. Moss) 6247
Scott, W. B., and W. J. Christie.
The invasion of the lower Great Lakes by the white perch, Roccus americanus (Gmelin). 6266
Seaman, D. E., and W. A. Porterfield.
Feasibility of controlling aquatic weeds with snails. 6324
Sehdev, H. S., J. R. McBride, and U. H. M. Fagerlund.
2-Phenoxyethanol as a general anesthetic for sockeye salmon. 6273
Serbenyuk, Ts. V., and Yu. B. Maiteifel'.
The effect of temperature on the physiological mechanism of fish. (K voprosu o fiziologicheskom mekhanizme deistviya temperatury na ryb.) 6436
Shell, E. W.
Effects of changed diets on the growth of channel catfish. 6354
Shelton, G. (See D. J. Randall) 6434
Shelton, G., and D. J. Randall.
The relationship between heartbeat and respiration in teleost fish. 6305
Sheppard, J. M. (See D. R. Huchson) 6238
Silver, Stuart J., Charles E. Warren, and Peter Doudoroff.
Dissolved oxygen requirements of developing steelhead trout and chinook salmon embryos at different water velocities. 6341
Simes, J. C.
Control of the pond weed, Potamogeton crispus, in both flowing and static situations with endothal. 6329
Potential uses of calcium cyanamid in the control of aquatic vegetation. 6334
Small, Lawrence F.
Effect of wind on the distribution of chlorophyll a in Clear Lake, Iowa. 6242
Smith, G.
Eurasian watermilfoil (Myriophyllum spicatum) in the Tennessee Valley. 6321
Smith, G. F. M. (See G. H. Lawler) 6272
Smith, M. (See U. H. M. Fagerlund) 6275
Smith, Philip W. (See R. Weldon Larimore) 6372
Smith, R. F. (See A. W. Horrocks) 6330
Smoker, William A.
Influence of fresh-water environment on survival of coho salmon. 6413
Sneed, Kermit E., and Howard P. Clemens.
The morphology of the testes and accessory reproductive glands of the catfishes (Ictaluridae). 6312
Sokolov, B. M.
Fish scales as organs of vision. (Cheshuya kak organ zreniya ryb.) 6306
Soong, Maureen H. H. (See D. S. Johnson) 6414
Sperry, R. W. (See H. L. Arora) 6379
Steucke, E. W.
Observations on the use of disodium endothal in fish hatchery ponds. 6340
Stewart, Kenneth W.
Observations on the morphology and optical properties of the adipose eyelid of fishes. 6307
Stokes, R. M. (See P. O. Fromm) 6389
Strong, F. M. (See Philip H. Derse) 6237

Summerfelt, R. C. (See William M. Lewis) 6359
Svetovidov, A. N.
The systematics, origin and history of distribution of the Eurasiatic and North American species of Perca, Lucioperca and Stizostedion. 6409
Swift, D. R.
Activity cycles in the brown trout (Salmo trutta Lin.). I. Fish feeding naturally. 6302
Switzer, C. M.
Control of aquatic weeds. 6320

Tanaka, Soichi.
Studies of the question of reproduction of salmon stocks. 6431
Tarzwell, C. M.
Development of water quality criteria for aquatic life. 6397
Templeton, W. L., and V. M. Brown.
Accumulation of calcium and strontium by brown trout from waters in the United Kingdom. 6398
Thomaston, W. W.
Results of experimental weed control experiments in Georgia farm ponds using simplified gravity flow techniques. 6323
Threadgold, Lawrence T. (See Arthur H. Houston) 6269
Timmons, F. L.
The status and prospects in aquatic weed control. 6331
Tölg, I. (See G. Molnar) 6380
Tomlinson, N. (See U. H. M. Fagerlund) 6275
Toth, Robert J. (See William Heubach) 6256
Troshin, A. S. (See V. I. Zhadin) 6433

U. S. Dept. of Health, Education, and Welfare.
National Water Quality Network. Annual compilation of data, October 1, 1961 - September 30, 1962. 6317
Underhill, James C.
Distribution in Minnesota of the subspecies of the percid fish Etheostoma nigrum, and of their intergrades. 6234

Vasil'ev, I. S.
The adaptive significance of the structure of spawning redds in salmon of the genus Oncorhynchus. (Ob adaptivnom znachenii stroeniya nerestovykh bugrov lososei roda Oncorhynchus.) 6432
Verduin, Jacob.
Radioactivity of suspensoids in aquatic habitats of northwestern Ohio. 6365
Verhoeven, L. A. (See F. J. Ward) 6346
Vibert, R.
Migrations of salmon and their return to their native river. (Viajes de los salmones y regreso al rio natal.) 6303
Vincent, Robert Earl
Biogeographical and ecological factors contributing to the decline of Arctic grayling, Thymallus arcticus Pallas, in Michigan and Montana. 6375
Wagner, Henry G., Edward F. MacNichol, Jr., and Myron L. Wolbarsht.
Functional basis for "on"-center and "off"-center receptive fields in the retina. 6401
Wahle, Roy J. (See Paul D. Zimmer) 6264
Ward, F. J., and L. A. Verhoeven.
Two biological stains as markers for sockeye salmon fry. 6346
Ward, Fredrick James.
Regular fluctuations in the annual abundance of Adams River race sockeye salmon and the operative of possible causal agents. 6376
Warren, Charles E. (See Stuart J. Silver) 6341
Watson, John E.
A method for tagging immature herring. 6263
Weatherley, A. H.
Thermal stress and interrenal tissue in the perch Perca fluviatilis (Linnaeus). 6314
Zoogeography of Perca fluviatilis (Linnaeus) and Perca flavescens (Mitchill) with special reference to the effects of high temperature. 6315
Welker, Bill Dean.
Summer food habits of yellow bass and black bullheads in Clear Lake. 6261
Wolbarsht, Myron L. (See Henry G. Wagner) 6401
Wolfert, David R.
The movements of walleyes tagged as yearlings in Lake Erie. 6351
Wolny, Pawel.
The use of purified town sewage for fish rearing. (Przydatność oczyszczonych ścieków miejskich do hodowli ryb.) 6377
Woodall, A. N. (See Gilles La Roche) 6407
Wyatt, Ellis J., and Ivan Pratt.
Myxobolus insidiosus sp. n., a myxosporidian from the musculature of Oncorhynchus tshawytscha (Walbaum). 6313

Yamagami, Kenjiro, and Hideo Mohri.
Phosphorus metabolism in fish eggs. IV. Column chromatographic separation of phospholipids in the rainbow trout during embryonic and postembryonic development. 6439
Zhadin, V. I., A. G. Rodina, and A. S. Troshin.
A study of the biological productivity of bodies of water using radioactive isotopes. (Izuchenie biologicheskoi produktivnosti vodoemov pri pomoshchi radioizotopov.) 6433
Zhadin, V. I., T. V. Zharova, and N. G. Ozeretskovakaya.
On the use of radioactive carbon and oxygen methods in studying the primary production of Lake Krasavitsa. (O primenenii radiouglerodnogo i kislorodnogo metodov pri izuchenii pervichnoi produktsii oz. Krasavitsa.) 6283
Zharova, T. V. (See V. I. Zhadin) 6283
Zimmer, Paul D., Roy J. Wahle, and Eugene M. Maltzeff.
Progress report, spring chinook salmon transplantation study, 1955-61. 6264

****

SUBJECT INDEX

Abramis brama,
  chironomid consumption, 6286
  harvest, effect on biological characteristics, 6299
Age and growth,
  alewife, annulus evaluation, 6350
  bass,
    largemouth, pond, Pennsylvania, 6348
    yellow, annulus formation, 6347
  catfish, channel, diet, 6354
  chub, creek, Iowa, 6262
  Coregonidae, competition between species, 6392
  crappie, lake, Iowa,
    black, 6311
    white, 6311
  equipment, scale projector, 6254
  fish, methods, 6284
  Lagodon rhomboides, nitrogen intake, 6411
  pike, northern, larvae, 6440
  salmon,
    chinook, sampling technique, 6371
    Pacific, scales, 6309
    sockeye, North Pacific, 6270
  sauger, reservoir, 6265
  sunfish, green, thyroid activity, 6349
  trout, rainbow, interracial hybridization, 6427
  tuna, bluefin, California, 6259
Albacore, taxonomy, 6395
Alburnus, metabolism, 6297
Alewife, annulus evaluation, 6350
Alosa pseudoharengus (see alewife)
Anatomy,
  blood, Pacific salmon, 6429, 6435
  contact organs, Cyprinodontidae, 6408
  diencephalon, fish, 6308
  eye,
    fish, 6437
    sturgeon, 6438
  eyelid, adipose, Pacific herring, 6307
  gill rakers, chars, 6310
  glands, interrenal, Teleosts, 6381
  heart,
    goldfish, 6399
    Selachians, 6400
  morphometry, white perch, 6266
  nerves, optic, regeneration, Astronotus ocellatus, 6379
  olfactory organ, Salmonidae, 6239
  retina, Atlantic salmon, 6406
  scales,
    alewife, 6350
    fish, 6306
    Pacific, salmon, 6309
  sound producing structures, fish, 6360
  testes, catfish, white, 6312
  tissue, interrenal, Perca fluviatilis, 6314
  tumors, rainbow trout, 6403
  various, effects of toxicants, fish, 6402
Aplodinotus grunniens (see drum, fresh-water)
Astronotus ocellatus, color discrimination, 6379
Bass,
  largemouth, growth, pond, 6348
  striped, food habits, 6256
  yellow,
    annuli formation, 6347
    food habits, 6261
Behavior,
  alarm, fish, 6357
  backgrounds, moving, fish, 6244
  conditioned,
    Astronotus ocellatus, 6379
    fish, 6378
  equipment, fish, SCUBA, 6238
  feeding, brown trout, 6302
  food specialization, Coregonidae, 6392
  light, Atlantic salmon, 6268
  sounds, fish, 6360
  spawning,
    Cyprinodontidae, 6408
    darter, shield, 6405
  various, marine fish, 6361
Benthos,
  lake,
    Chironomidae, 6240, 6286
    detritus, 6241
  ocean, symposium, 6361
  ponds, predacious insect control, 6288
  Red Tide effects, 6257
  reservoir, fauna, 6364
  river, bottom deposits, 6281
Bibliography, aquatic sciences, 6385
Biocides,
  herbicides,
    calcium cyanamid, 6334
    disodium endothal, 6326, 6332, 6340
    Kuron, 6335
    review, 6328, 6331
    2, 4-D, 6321, 6330, 6336, 6339
    various, 6320, 6322, 6323, 6325, 6327, 6333, 6337, 6338, 6367, 6370, 6382, 6404, 6416
  insecticides,
    DDT, 6235, 6352
    various, 6353, 6374, 6393
  piscicides,
    antimycin, 6237
    polychlorpinene, 6387, 6388
    rotenone, 6285, 6290, 6295
  various,
    streams, U. S., 6317
    toxicity, fish, 6396
Bluegill, toxicity,
  alkyl benzene sulfonate, 6345
  herbicides, 6370
Buffalo, bigmouth, life history, 6271

Carassius auratus (see goldfish)
Carp,
  chironomid consumption, 6286
  culture,
    Russia, 6390

Carp, cont.
culture, cont.
sewage lagoons, 6377
harvest, Iowa, 6424
removal, reservoir, 6343
toxicity, insecticides, 6393
vision, 6306
Catfish,
blood, hemoglobin determination, 6246
channel,
diet, 6354
harvest, Iowa, 6424
respiratory metabolism, 6247
flathead, removal, reservoir, 6343
testes,
various, 6312
white, 6312
Catostomus commersoni (see sucker, white)
Char, food habits, 6310
Chemical factors,
nitrogen, turnover, estuary, 6411
oxygen,
embryo development, Salmonids, 6341
spawning beds, pink salmon, 6410
winter-kill, prevention, Russia, 6388
various,
Red Tide, 6318
respiration, Tinca tinca, 6434
sewage lagoons, 6377
stream, 6317
strip mine ponds, 6250
toxicants, sublethal concentration, 6402
water quality criteria, 6397
Chub, creek, life history, 6262
Clupea harengus pallasi (see herring, Pacific)
Cod, reaction, moving backgrounds, 6244
Competition, Coregonidae, 6392
Coregonidae, competition, 6392
Crappie, growth, Iowa,
black, 6311
white, 6311
Culture,
carp,
fry density, effect on zooplankton, 6390
sewage lagoons, 6377
fish, predacious insect control, 6288
muskellunge, rearing pond, Iowa, 6394
sturgeon, Russia, 6438
trout, strip mine ponds, 6250
Cyprinodontidae, spawning behavior, 6408
Cyprinus carpio (see carp)

Darter,
Johnny, distribution and taxonomy, 6234
shield, spawning behavior, 6405
Diet,
catfish, channel, effect of changes, 6354
pike, northern, survival, 6440
trout,
brown, dry concentrates, 6248
rainbow,
trace substances, 6301
tumors, 6403
Disease,
Aeromonas
liquefaciens, golden shiner, 6251
salmonicida, trout, various, 6245
furunculosis, agar, crystal formation, 6249
hepatoma, rainbow trout, 6344, 6403
Distribution,
darter, Johnny, 6234
Lucioperca, 6409
minnows, Maryland, 6430
Perca, 6315, 6409
shiner, blacknose, 6422
Stizostedion, 6409
Drugs,
antibiotics, diet, rainbow trout, 6301
biomycin, Ichthyophthirius, rainbow trout, 6289
formalin, fish preservative, 6274
2-phenoxyethanol, anesthetic, sockeye salmon, 6273
Drum, fresh-water, removal, reservoir, 6343

Ecology,
Bryozoa, farm ponds, 6243
buffalo, bigmouth, 6271
fish,
bases for population dynamics, 6293
eye development, 6437
textbook, Russia, 6428
grayling, Arctic, 6375
salmon, sockeye, distribution of spawning, 6296
stream, Illinois, 6372
Teleosts, interrenal glands, 6381
Economics, commercial fishing, 6287, 6366
Electricity, lamps, predacious insect control, 6288
Embryology,
pike, northern, temperature and light, 6300
Salmonids, oxygen requirements, 6341
sturgeon, eyes, 6438
trout, rainbow, 6342, 6439
Equipment,
dams, polyethylene, 6285
feeder, fry, 6255
nets,
gill, monofilament vs. multifilament, 6373
recovery, 6252
picker, plankton, 6236
projector, scale, 6254
recorder, pressure changes, gills, 6304
sampler,
plankton, 6358
water, 6359
SCUBA, lake survey, 6238
tags, stainless steel anchor, 6276
trap, scoop, 6253
Esox
lucius (see pike, northern)
masquinongy (see muskellunge)
Etheostoma nigrum (see darter, Johnny)

Fertilization, pond,
primary production, 6282

Fertilization, pond, cont.
Russia, 6433
Food habits,
bass,
striped, 6256
yellow, 6261
buffalo, bigmouth, 6271
chars, 6310
chub, creek, 6262
Coregonidae, 6392
fish,
Russia, 6286
study method, 6355
Lagodon rhomboides, 6411
Thymallus thymallus, 6369
trout, brown, 6302

Gambusia affinis (see mosquitofish)
Gasterosteus aculeatus (see stickleback, threespine)
Genetics,
evolution, bony fishes, 6361
hybrid, interracial, rainbow trout, 6427
Goldfish,
anatomy, heart, 6399
chironomid consumption, 6286
retina, receptive field, 6401
Grayling, Arctic, decline, 6375
Guppy,
introduction, Malaya, 6414
toxicant effects, 6402

Harvest,
fish,
commercial,
effects on biological characteristics, 6299
lakes, Russia, 6388
marine, California, 6366
reservoir, 6343
sport, Iowa, 6424
muskellunge, estimate, 6267
salmon,
coho, stream discharge, 6413
Pacific, monofilament vs. multifilament gill nets, 6373
sockeye, North Pacific, 6270
trout, rainbow, interracial hybrids, 6427
Herring,
Pacific, anatomy, adipose eyelid, 6307
reaction, moving backgrounds, 6244
tagging, juveniles, 6263

Ictalurus
catus (see catfish, white)
punctatus (see catfish, channel)
Ictiobus cyprinellus (see buffalo, bigmouth)
Identification, salmon, various, stage of maturity, 6423

Lagodon rhomboides, nitrogen cycle, 6411
Lebistes reticulatus (see guppy)
Lepomis
cyanellus (see sunfish, green)
macrochirus (see bluegill)
Life history,
buffalo, bigmouth, 6271
chub, creek, 6262
fish, general, 6428
sauger, 6265
Limnology, review, North America, 6386
Lucioperca lucioperca, gastric digestion, 6380

Mackerel, Pacific, taxonomy, 6395
Management,
endangered fish species, 6412
fish,
commercial, North Pacific, 6356
eradication, Russia, 6387
inland fisheries, Maryland, 6277
lakes, Russia, 6388
water, evaporation control, 6383
Micropterus salmoides (see bass, largemouth)
Migration and movement,
fish,
moving backgrounds, 6244
navigation locks, 6298
herring, 6263
perch, white, 6266
phytoplankton, 6242
salmon,
chinook, 6264, 6319
coho, 6414
Pacific, 6419
sockeye, 6275
various, 6303
tuna, bluefin, 6260
walleye, 6351
Minnow,
flathead, toxicity,
calcium cyanamid, 6334
rotenone, 6290
various, distribution, Maryland, 6430
Mollienessia, introduction, Malaya, 6414
Mosquitofish,
introduction, Malaya, 6414
toxicity, insecticides, 6374
Muskellunge,
exploitation estimate, 6267
stocking, Iowa, 6394

Notemigonus crysoleucas (see shiner, golden)
Notropis heterolepis (see shiner, blacknose)

Oceanography, symposium, Germany, 6361
Oncorhynchus
gorbuscha (see salmon, pink)
keta (see salmon, chum)
kisutch (see salmon, coho)
nerka (see salmon, sockeye)
tshawytscha (see salmon, chinook)

Paddlefish, removal, reservoirs, 6343
Palaemonetes paludosus, introduction, Colorado River, 6258
Parasites,
Ichthyophthirius, rainbow trout, 6289
Myxobolus insidiosus, chinook salmon, 6313
various, fish, 6316

Perca
flavescens (see perch, yellow)
fluviatilis,
anatomy, diencephalon, 6308
embryology, 6300
harvest, effects on biological characteristics, 6299
parasites, 6316
reaction, moving backgrounds, 6244
systematics and history, 6409
thermal stress, 6314
zoogeography, 6315
Perch,
white, migration, 6266
yellow,
systematics and history, 6409
zoogeography, 6315
Percina peltata (see darter, shield)
Physical factors,
evaporation, reservoirs, 6383
temperature,
distribution, fish, 6425
mortality, chinook salmon, 6319
oxygen consumption, fish, 6436
Perca fluviatilis, 6314, 6315
perch, yellow, 6315
stream,
effect of snow cover, 6418
preimpoundment study, trout, 6420
turbidity, rotenone toxicity, 6290
vaporization, vegetation interception, 6384
various,
embryo development, fish, 6300
Red Tide, 6318
velocity, embryo development, Salmonids, 6341
Physiology,
alarm substances, fish, 6357
blood, hemoglobin, catfish, 6246
body fluid regulation, Atlantic salmon, 6269
digestion, Lucioperca lucioperca, 6380
glands, interrenal, Teleosts, 6381
metabolism,
chromium assimilation, trout, 6389
iodine, chinook salmon, 6407
planktophagous fish, 6397
olfactory, sockeye salmon, 6275
oxygen consumption, organs and tissues, fish, 6436
phospholipids, rainbow trout, 6439
respiration,
effect of gas concentrations, Tinca tinca, 6434
equipment, fish, 6304
heartbeat, fish, 6305
metabolism, channel catfish, 6247
retina,
receptive fields, goldfish, 6401
responses to light, Atlantic salmon, 6406
thyroid, green sunfish, 6349
tissue, interrenal, Perca fluviatilis, 6314
various, herbicide effects, fish, 6404
vision,
color discrimination, 6379
Physiology, cont.
vision, cont.
eye development, 6437
fish, 6306
Pacific herring, 6307
Pike,
northern,
embryology, 6300
harvest, 6299
parasites, 6316
survival, larvae, 6440
vision, 6306
reaction, moving backgrounds, 6244
Pimephales promelas (see minnow, fathead)
Plankton,
equipment,
picker, 6236
sampler, 6358
phyto-
chlorophyll, 6242
lake, primary production, 6280
marine, primary production, 6278
pond, primary production, 6282
reservoirs, production, 6363
volume, radioactivity, 6365
zoo-
Bryozoa, 6243
Palaemonetes paludosus, introduction, 6258
ponds, carp culture, 6390
reservoirs, fauna, 6364
Pollution,
coal distillation, rainbow trout, 6294
detergents, synthetic, biological effects, 6279
organic, stream, benthos, 6281
various,
classification, 6397
stream,
Illinois, 6372
U. S., 6317
sublethal concentrations, guppy, 6402
survival, fish, 6414, 6415
Polyodon spathula (see paddlefish)
Pomoxis
annularis (see crappie, white)
nigromaculatus (see crappie, black)
Populations,
bass, largemouth, pond, Pennsylvania, 6348
crappie, various, Iowa, 6311
fish,
bases for dynamics, 6293
effects of harvest, 6299
environmental gradients, 6425
estimation,
effect of colored tags, 6272
method, 6417
marine, predatory relationship, 6291
mathematical models, 6391
stream, Illinois, 6372
salmon,
coho, stream discharge, 6413
Pacific, Siberia, 6419
sockeye,
sea, North Pacific, 6270

Populations, cont.
salmon, cont.
sockeye, cont.
stream, Adams River, 6376
Predation,
fish,
colored tags, effects, 6272
populations, effects, 6291
insects, control, 6288
Production, primary,
lake,
chlorophyll method, 6280
Russia, 6283
marine, luminescent analysis, 6278
ponds, Latvia, 6282
Pylodictis olivaris (see catfish, flathead)

Radiology,
C^{14}, lakes, primary production, 6283
Ca^{45}, absorption, bottom soils, 6433
contamination, streams, U. S., 6317
I^{27}, uptake, chinook salmon, 6407
P^{32},
absorption, bottom soils, 6433
food chain, 6362
S^{35}, insecticide, uptake by minnows, 6416
suspensoids, 6365
various, accumulation, brown trout, 6398
Red Tide,
mortality, marine organisms, 6257
organism counts, 6318
Rehabilitation, lakes, fish, Russia, 6387, 6388
Reproduction,
buffalo, largemouth, sexual maturation, 6271
Cyprinodontidae, spawning behavior, 6408
darter, shield, spawning behavior, 6405
salmon,
Pacific,
Alaska, 6421
redd structure, 6432
studies, 6431
pink, spawning bed quality, 6410
sockeye, spawning, 6296
Roccus
americanus (see perch, white)
mississippiensis (see bass, yellow)
saxatilis (see bass, striped)
Rutilus rutilus,
chironomid consumption, 6286
parasites, 6316

Salmo
clarki (see trout, cutthroat)
gairdneri (see trout, rainbow)
salar (see salmon, Atlantic)
trutta (see trout, brown)
Salmon,
Atlantic,
body fluid regulation, 6269
light stimuli, 6268
parasites, 6316
retina, 6406
chinook,
age composition, sampling technique, 6371
Salmon, cont.
chinook, cont.
embryos, oxygen requirements, 6341
introductions, streams, 6264
metabolism, iodine, 6407
parasites, 6313
return to hatchery, 6319
scales, 6309
chum,
index of maturity, 6423
scales, 6309
coho,
scales, 6309
survival, 6413
Pacific,
blood,
elements, changes, 6435
types, 6429
decline, 6368
equipment, trap, 6253
formalin, effect on length and weight, 6274
harvest, monofilament vs. multifilament gill nets, 6373
redd structure, 6432
reproduction, 6431
return, 6419
pink,
escapements, 6421
scales, 6309
spawning beds, 6410
sockeye,
abundance, fluctuations, 6376
anesthetic, 6273
ecological distribution of spawning, 6296
escapements, 6421
index of maturity, 6423
marking, stains, 6346
migration, 6275
scales, 6309
yield, North Pacific, 6270
various, migration, 6303
Salmonidae, olfactory organ, 6239
Salvelinus fontinalis (see trout, brook)
Sampling,
chinook salmon, age composition, 6371
fish, "chemical dams," 6285
Sauger, life history, 6265
Scomber japonicus (see mackerel, Pacific)
Selachians, anatomy, heart, 6400
Semotilus atromaculatus (see chub, creek)
Shiner,
blacknose, distribution, Iowa, 6422
golden, disease, Aeromonas liquefaciens, 6251
Smelt, reaction, moving backgrounds, 6244
Stickleback, threespine, reaction, moving backgrounds, 6244
Stizostedion
canadense (see sauger)
vitreum (see walleye)
Sturgeon, eye development, 6348
Stocking and introductions,
fish,
fresh-water, Malaya, 6414
reservoirs, 6292

Stocking and introductions, cont.
fish, cont.
Russia, 6388
food organisms, Colorado River, 6258
muskellunge, Iowa, 6394
salmon, chinook,
returns, 6319
stream, 6264
Sucker, white, mortality, herbicides, 6320
Sunfish, green, thyroid activity, 6349
Survival,
bluegill,
alkyl benzene sulfonate, 6345
herbicides, 6370
endangered fish species, 6412
fish,
biocides, application methods, 6396
estimation, 6417
herbicides, 6367
introductions, Malaya, 6414
pollution, 6415
fresh-water fauna, insecticides, 6393
guppy, toxicants, 6402
marine organisms, Red Tide, 6257
minnow, fathead, calcium cyanamid, 6334
mosquitofish, insecticides, 6374
muskellunge, tagging, 6267
pike, northern, larvae, 6440
red crawfish, insecticides, 6353
salmon,
chinook, return to hatchery, 6319
coho, stream discharge, 6413
Pacific,
eggs, 6432
Siberia, 6419
pink, spawning bed quality, 6410
sockeye, marking stains, 6346
Salmonids, embryos, 6341
trout,
cutthroat, DDT, 6235
rainbow, interracial hybridization, 6427

Tagging and marking,
anchor-type, fish, 6276
stains, sockeye salmon fry, 6346
tubing, juvenile herring, 6263
various, fish, 6272
Taxonomy,
Etheostoma nigrum, 6234
Lucioperca, 6409
mackerels, 6395
Perca, 6409
Stizostedion, 6409
Teleosts, 6381
tunas, 6395
Thunnus
alalungua (see albacore)
albacares (see tuna, yellowfin)
obesus (see tuna, bigeye)
thynnus (see tuna, bluefin)
Thymallus
arcticus (see grayling, Arctic)
thymallus,
food habits, 6369

Thymallus, cont.
thymallus, cont.
parasites, 6316
Tilapia mossambica, vegetation control, 6331
Tinca tinca,
harvest, effects on biological characteristics, 6299
respiration, 6434
Trout,
brook, disease, Aeromonas salmonicida, 6245
brown,
calcium accumulation, 6398
diet, 6248
disease, Aeromonas salmonicida, 6245
food habits, 6302
parasites, 6316
reaction, moving backgrounds, 6244
chromium, assimilation and metabolism, 6389
cutthroat, DDT, toxicity, 6235
habitat, preimpoundment study, 6420
rainbow,
anatomy, diencephalon, 6308
development, embryonic and larval, 6342
diet, trace substances, 6301
disease, hepatoma, 6344, 6403
embryo, oxygen requirements, 6341
interracial hybridization, 6427
parasite, Ichthyophthirius, 6289
phospholipids, 6439
pollution, toxicity, 6294
Tuna,
bigeye, taxonomy, 6395
bluefin,
age determination, 6259
migration, 6260
taxonomy, 6395
skipjack, taxonomy, 6395
yellowfin, taxonomy, 6395

Vegetation,
aquatic,
control,
calcium cyanamid, 6334
disodium endothal, 6326, 6332, 6340
herbicides, various, 6320, 6322, 6323, 6325, 6333, 6337, 6338, 6404, 6416
Kuron, 6335
polyethylene plastic, 6426
review, 6328
snails, 6324
survey, 6331
2, 4-D, 6336, 6339
water supply reservoir, 6327
Eurasian watermilfoil, control, 6321
growth factors, 6382
Myriophyllum spicatum, control, 6330
Potamogeton crispus, control, 6329
terrestrial, precipitation interception, 6384

Walleye,
harvest, Iowa, 6424
movement, Lake Erie, 6351
Water developments,

Water developments, cont.
dredging, stream, fish, 6372
farm ponds,
Bryozoa, 6243
DDT, 6352
limnology, 6386
vegetation control, 6323, 6426
reservoirs,
evaporation control, 6383
fish,
passage through navigation locks, 6298
stocking, 6292
Water developments, cont.
reservoirs, cont.
limnology, 6386
plankton, 6363
preimpoundment study, 6420
removal, rough fish, 6343
rotenone, taste and odor, 6295
sauger, 6265
water supply, herbicides, 6327
zooplankton, 6364
sewage lagoons, fish rearing, 6377

****

Created in 1849, the Department of the Interior--America's Department of Natural Resources--is concerned with the management, conservation, and development of the Nation's water, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States--now and in the future.

FISH
RESTORATION